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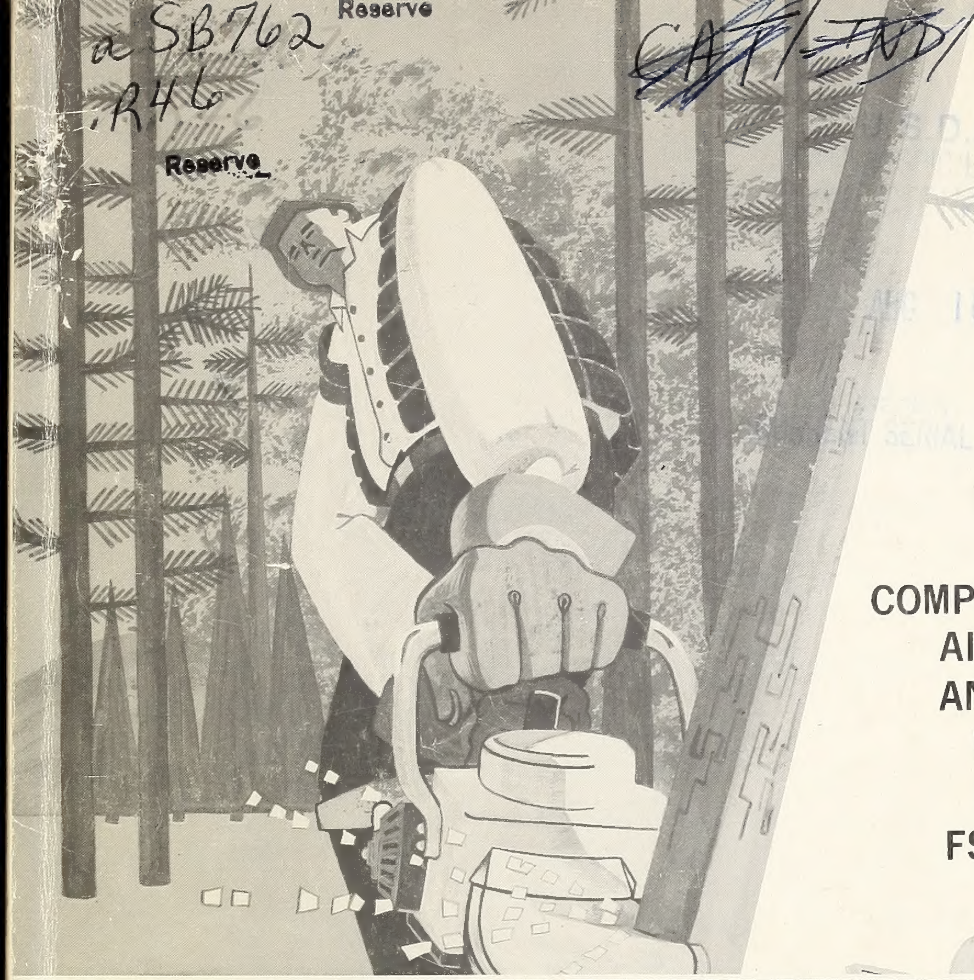
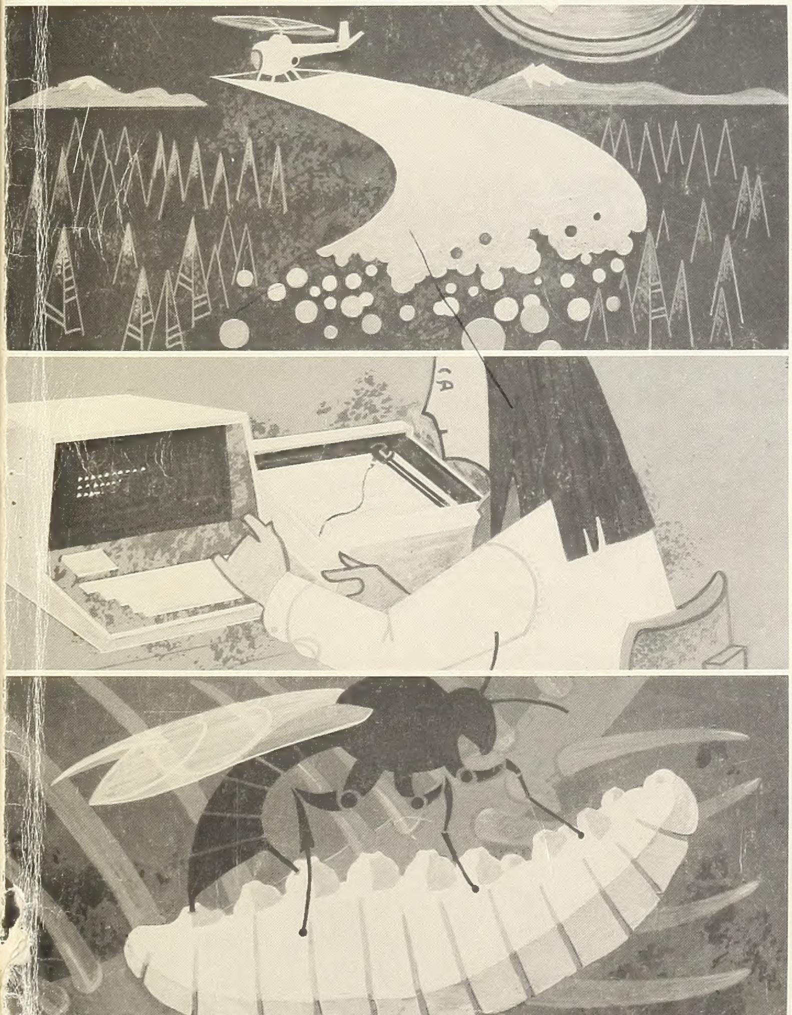
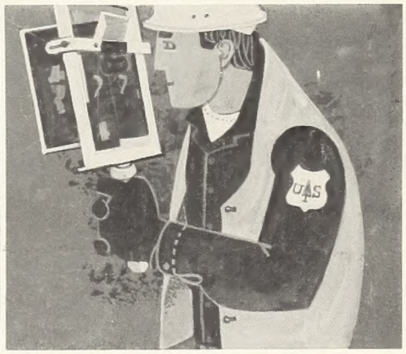


COMPUTER MODELS FOR PREDICTING AIRCRAFT SPRAY DISPERSION AND DEPOSITION ABOVE AND WITHIN FOREST CANOPIES: USER'S MANUAL FOR THE FSCBG COMPUTER PROGRAM.





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Report No. 80-11 October 1980

COMPUTER MODELS FOR PREDICTING AIRCRAFT SPRAY DISPERSION AND DEPOSITION ABOVE AND WITHIN FOREST CANOPIES: USER'S MANUAL FOR THE FSCBG COMPUTER PROGRAM[1]

R. K. Dumbauld, J. R. Bjorklund and S. F. Saterlie[2]

ABSTRACT

The FSCBG computer program described in this report combines and implements mathematical models for aircraft wake effects, line-source dispersion, drop evaporation and canopy penetration. The computer program is designed to account for the atmospheric dispersion, transport and deposition of all aerial spray material from the time of release until all spray material is either deposited or, in the case of spray drift beyond a target area, spray concentration and deposition levels are insignificant. Specific calculations made by the computer program include spray concentrations and dosages above forest canopies as well as the spray deposition within and below forest canopies resulting from aerial spray releases made along single or multiple flight paths. Important applications of the computer program are the optimization of spray program design and operation with respect to the selection of aircraft spray systems, flight altitudes, swath widths, spray rates, and scheduling of spray operations; evaluation and analysis of field measurements of spray deposition; and, assessments of the environmental impact or hazard posed by aerial spray operations.

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1 Prepared for USDA-Forest Service, Forest Insect and Disease Management Application Group, Davis, CA under Contract No. 53-91S8-9-6127; John W. Barry, USDA-Forest Service, Project Officer.

2 H. E. Cramer Company, Inc., Post Office Box 8049, Salt Lake City, UT 84108.

SECTION 1
INTRODUCTION

1.1 BACKGROUND

The USDA Forest Service (USFS) uses aerial spray applications to prevent and suppress tree damage due to pest infestations. As part of an extensive program to develop and evaluate pest management systems, the USFS is interested in achieving a complete understanding of the behavior of spray material from the time spray is released from the aircraft until it has been deposited or, in the case of spray drift, dissipated to concentration/dosage levels that are environmentally insignificant. Because mathematical spray dispersion models are useful in determining interactions of the many factors affecting spray operations, the USFS has supported the application and development of these models over the last decade. Simplified aerial line source models developed for the US Army were applied (GCA Corporation, 1971; H. E. Cramer Company, 1973) early in the decade to determine optimum swath widths and application rates for use in pilot tests of insecticides under consideration at that time for control applications in western forests. The implications of these early efforts in the use of mathematical models to improve the planning, conduct and analysis of spray programs were reviewed in a paper presented at the USFS Workshop for Aerial Application of Insecticides Against Forest Defoliators, held in Missoula, Montana, 23-29 April 1974 (Dumbauld, Cramer and Barry, 1975). The H. E. Cramer Company (Dumbauld and Bjorklund, 1977) used aerial spray dispersion models to assist the State of Maine Bureau of Forestry in determining offset distances required for various aircraft to ensure that drift from spray blocks in the Maine 1977 spray program posed no environmental hazard to exclusion areas (waterways, homes, etc.) in the vicinity of the spray blocks. Under the sponsorship of the USDA Expanded Douglas-fir Tussock Moth Research and Development Program, work began in early 1977 on the development of a technical data base for use in applying mathematical dispersion models to USFS spray projects and the refinement

and adaptation of existing models to predict spray behavior above and within forest canopies. This work (Dumbauld, Rafferty and Bjorklund, 1977) resulted in the development of the CBG computerized spray dispersion model and the comparison of model predictions with measurements made during selected USFS spray programs. The CBG computer program has recently been applied in the development of optimum swath widths, application rates, and aircraft altitudes for the conduct of a pilot project in the Withlacoochee State Seed Orchard Project (Rafferty and Dumbauld, 1980) and is currently being used in evaluating the results of the project. The USFS (Dumbauld, Bowman and Rafferty, 1980) has also sponsored the use of the CBG model to determine optimum swath widths and spray altitudes for specific spray aircraft planned for use in the Maine 1980 Spray Program. A general discussion of spray behavior in and above canopies can be found in the report describing research funded by the USDA Expanded Douglas Fir Tussock Moth Research and Development Program (Brookes, Stark and Campbell, 1978).

The CBG computer based model is comprised of two major parts. The first part simulates the deposition of spray drops at the top of a forest canopy. The second part, which is based on a model developed by Grim and Barry (1975), simulates the penetration of spray drops into the forest canopy. This report describes a new computer program developed under the sponsorship of Methods Application Group, USFS (MAG) to extend the usefulness of the modeling concepts and applicability of the CBG computer based model.

1.2 PURPOSE

The primary purpose for the development of the FSCBG computer program described in this report was to extend the CBG computer based model to include the effects of spray drop evaporation on the spray deposition patterns and drift concentration/dosage levels. Because the program changes for including evaporation effects were extensive, the decision was

made to construct the new program in a modular fashion to ensure that further updates in the various calculation procedures could be more easily accomplished. Also, many calculations for deriving input parameters, such as the gravitational settling velocity of drops, are performed automatically, on user option, by the new program.

1.3 GENERAL DESCRIPTION OF THE FSCBG COMPUTER PROGRAM

The FSCBG computer program implements an aircraft wake-settling velocity model, line-source dispersion models, a drop evaporation model and a canopy penetration model to calculate the concentration, dosage and deposition above and below a forest canopy downwind from multiple aircraft spray lines or swaths. The program is written in FORTRAN IV and is designed for implementation on a UNIVAC 1108 computer, although the program is easily adapted to other computer systems. The computer program requires 32K words of core storage. Figure 1-1 is a schematic diagram showing the major components of the FSCBG program. As indicated in the figure, program control parameters, as well as source and meteorological data are input to the program via card image. The input requirements of the program are discussed in detail in Section 3. Definitions of the meteorological and source inputs and their relationships to the various program models are given in Section 2. Figure 1-1 shows that the user may select a number of model options. The Above Canopy and Below Canopy Evaporation Model option allow the user to specify whether or not drop evaporation is to be included in a calculation of concentration, dosage and deposition. If the user selects a drop evaporation option, the program automatically calculates the change in drop diameter with time, using a polynomial expression fitted either to empirical data or theoretical calculations. The Wake-Settling Velocity Model option permits the user either to input the aircraft wake-settling velocity directly or to input the aircraft weight, wing span and ground speed which the program uses to calculate the aircraft wake-settling velocity.

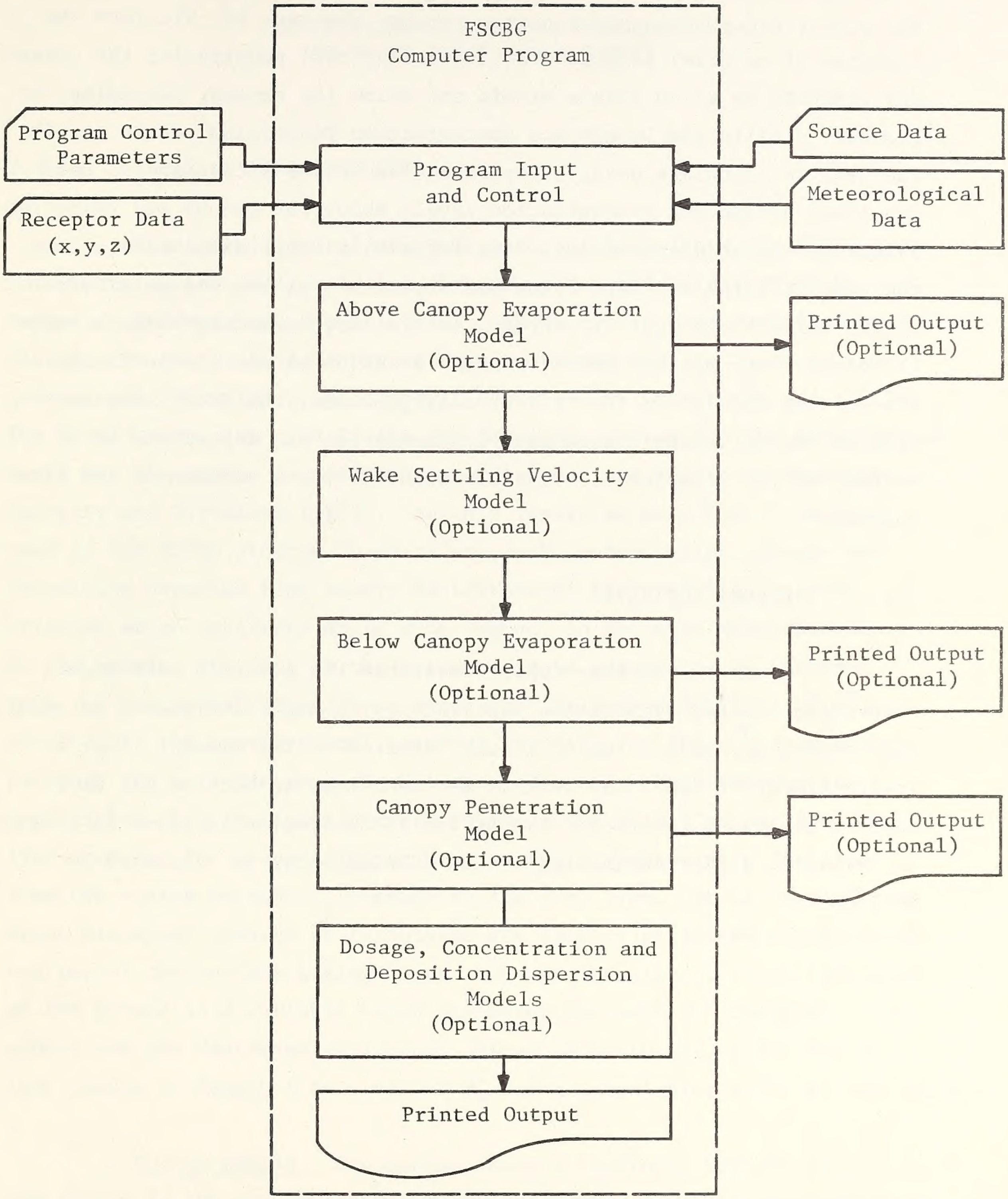

FIGURE 1-1. Schematic diagram of the FSCBG computer program.

The Canopy Penetration Model option permits the user to calculate the fraction of material presented at the canopy top, penetrating the canopy and reaching up to 10 levels within and below the canopy, including the ground. Finally the Dosage and Concentration Dispersion models permit the user to calculate dosage, concentration and area coverage of user specified dosage and concentration levels above the canopy and below the height of elevated inversions. The Deposition Dispersion Model allows the user to calculate deposition and deposition area-coverage at any height below the height of elevated inversions, including heights below the canopy top when the model is used in conjunction with the Canopy Penetration Model. In its present configuration, the FSCBG computer program can calculate the dosage, concentration and deposition at a maximum of 737 receptor coordinates downwind from a maximum of 100 line sources.

1.4 REPORT CONTENTS

Section 2 of this report describes the aircraft wake model, dispersion models, evaporation model, canopy penetration model, as well as the meteorological and source inputs required by the models. User's instructions for the FSCBG program are contained in Section 3. An example problem illustrating use of the FSCBG program is given in Section 4. Finally, a FORTRAN listing of the FSCBG program is contained in Section 5.

SECTION 2

DESCRIPTION OF THE FSCBG MODELS AND MODEL INPUT REQUIREMENTS

2.1 SPRAY DISPERSION MODELS

The spray dispersion models incorporated within the FSCBG computer program are similar to the aircraft spray models described by Dumbauld, Rafferty and Cramer (1976). These models were developed previously for the U. S. Army Dugway Proving Ground and are based on the generalized diffusion model concepts described by Cramer, et al. (1972). The models were also used in the CBG computer program and the mathematical basis for the models is given in Appendix B of the report by Dumbauld, Rafferty and Bjorklund (1977). In this report we describe the models used in the FSCBG program to calculate peak concentration, dosage and deposition downwind from nearly-instantaneous elevated line sources oriented at an arbitrary angle with respect to the mean wind direction. In the models, the axis of the spray cloud is assumed to be inclined from the horizontal plane by an angle that is proportional to $(V_j/\bar{u})$, where V_j is the gravitational settling velocity for the j^{th} drop-size category and $\bar{u}$ is the mean cloud transport speed. When evaporation is negligible, this inclination angle is invariant with distance from the line source. For evaporating drops, the angle changes with distance from the source because V_j depends on the drop size. It is assumed that drops dispersed upwards by turbulence are totally reflected downwards at the top of the surface mixing layer, but the fraction of drops reflected at the ground is a variable input parameter for each j^{th} category. The models use the Cartesian coordinate system shown in Figure 2-1 for a line source of length L at a height H_j' and a calculation point at $R(\varepsilon, \delta, z)$.

Dosage Models. The dosage (mass $\times$ time/unit volume) above the canopy is the sum of contributions from drops in the dispersing cloud

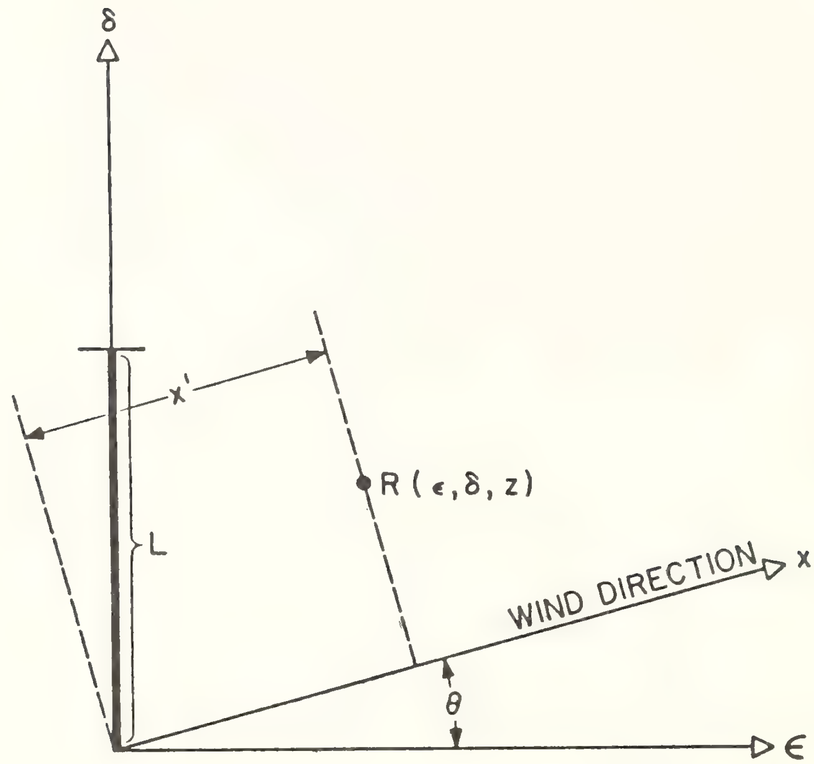

FIGURE 2-1. Schematic plan view showing the line source geometry with respect to a calculation point at R(ε, δ, z) for a wind direction θ.

and from vapor produced by drop evaporation. The above canopy dosage for the contribution from drops is given by the expression

$$D_L = \frac{S}{k\ \sigma_A'\ \sin\theta\ \bar{u}} \sum_{j=1}^{J} f_j \left\{ \sum_{i=0}^{\infty} \left[\gamma_j^{\ i} \left(\frac{\pi}{2Y}\right)^{1/2} \left\{ \exp\left(\frac{O^2}{4Y}\right) - P \right\} \right. \right.$$

$$\left\{ \mathrm{erf}\left(Y^{1/2}\left(\frac{k}{a} + \frac{O}{2Y}\right)\right) - \mathrm{erf}\left(Y^{1/2}\left(\frac{k}{b} + \frac{O}{2Y}\right)\right) \right\}$$

$$\left. + \gamma_j^{\ i+1} \left(\frac{\pi}{2Z}\right)^{1/2} \left\{ \exp\left(\frac{R^2}{4Z} - P\right) \right\} \left\{ \mathrm{erf}\left(Z^{1/2}\left(\frac{k}{a} + \frac{R}{2Z}\right)\right) - \mathrm{erf}\left(Z^{1/2}\left(\frac{k}{b} + \frac{R}{2Z}\right)\right) \right\} \right] \tag{2-1}$$

$$+ \sum_{i=1}^{\infty} \left[\gamma_j^{\ i} \left(\frac{\pi}{2T}\right)^{1/2} \left\{ \exp\left(\frac{U^2}{4T} - P\right) \right\} \left\{ \mathrm{erf}\left(T^{1/2}\left(\frac{k}{a} + \frac{U}{2T}\right)\right) - \mathrm{erf}\left(T^{1/2}\left(\frac{k}{a} + \frac{U}{2T}\right)\right) \right\} \right.$$

$$\left. \left. + \gamma_j^{\ i-1} \left(\frac{\pi}{2W}\right)^{1/2} \left\{ \exp\left(\frac{X}{4W} - P\right) \right\} \left\{ \mathrm{erf}\left(W^{1/2}\left(\frac{k}{a} + \frac{X}{2W}\right)\right) - \mathrm{erf}\left(W^{1/2}\left(\frac{k}{b} + \frac{X}{2W}\right)\right) \right\} \right] \right\}$$

where

$$S = Qk/2\pi L \tag{2-2}$$

$$Y = \frac{1}{k^2} \left[n - \frac{\delta}{\cos\theta} \right]^2 + \left[c + z \right]^2 \tag{2-3}$$

$$O = \frac{2^{1/2}}{\sigma_A' k} \left[\frac{k^2 V_j}{\bar{u}} \left(c + z \right) - \left(n - \frac{\delta}{\cos\theta} \right) \cot\theta \right] \tag{2-4}$$

$$P = \left[\frac{kV_j}{2^{1/2}\sigma_A' \bar{u}}\right]^2 + \left[\frac{\cot\theta}{2^{1/2}\sigma_A'}\right]^2 \tag{2-5}$$

$$Z = \frac{1}{k^2}\left[n - \frac{\delta}{\cos\theta}\right]^2 + \left[D + z\right]^2 \tag{2-6}$$

$$R = -\frac{2^{1/2}}{\sigma_A' k}\left[\frac{k^2 V_j}{\bar{u}}\left(D + z\right) + \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \tag{2-7}$$

$$T = \frac{1}{k^2}\left[n - \frac{\delta}{\cos\theta}\right]^2 + \left[D - z\right]^2 \tag{2-8}$$

$$U = -\frac{2^{1/2}}{\sigma_A' k}\left[\frac{k^2 V_j}{\bar{u}}\left(D - z\right) + \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \tag{2-9}$$

$$W = \frac{1}{k^2}\left[n - \frac{\delta}{\cos\theta}\right]^2 + \left[C - z\right]^2 \tag{2-10}$$

$$X = \frac{2^{1/2}}{\sigma_A' k}\left[\frac{k^2 V_j}{\bar{u}}\left(C - z\right) - \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \tag{2-11}$$

$$C = 2iH_m - H_j' - \left(V_j x_V / \bar{u}\right) \tag{2-12}$$

$$D = 2iH_m + H_j' + \left(V_j x_V / \bar{u}\right) \tag{2-13}$$

$$a = 2^{1/2}\,\sigma'_A \left(x' + x_V - \ell \sin\theta\right) \quad (2\text{-}14)$$

$$b = 2^{1/2}\,\sigma'_A \left(x' + x_V)\right) \quad (2\text{-}15)$$

$$n = \left(x' + x_V\right)\cot\theta + x'\tan\theta = \left(\varepsilon/\sin\theta\right) + \left(\delta/\cos\theta\right) + x_V\cot\theta \quad (2\text{-}16)$$

$$x' = \left(\varepsilon + \delta \tan\theta\right)\cos\theta = \varepsilon\cos\theta + \delta\sin\theta \quad (2\text{-}17)$$

x_V = virtual distance

$$= \frac{k\sigma_o}{\sigma'_A} - x_R = \frac{\sigma_o}{\sigma'_E} - x_R \quad (2\text{-}18)$$

ℓ = effective line length

$$= \left\{\begin{array}{ll} \delta + \varepsilon \cot\theta & ;\ \delta + \varepsilon\cot\theta \leq L \\ L & ;\ \delta + \varepsilon\cot\theta > L \end{array}\right\} \quad (2\text{-}19)$$

The following parameters used in the preceding equations are based on meteorological measurements or inferred from meteorological measurements:

σ'_A = standard deviation of the wind azimuth angle in radians

k = constant relating σ'_A and σ'_E

$$= \sigma'_A/\sigma'_E \qquad (2\text{-}20)$$

σ'_E = standard deviation of the wind elevation angle in radians

H_m = depth of the surface mixing layer below a capping inversion

$\bar{u}$ = mean transport wind speed above the canopy

θ = angle between a line perpendicular to the line source and the mean wind direction (see Figure 2-1)

$\Delta\bar{u}$ = vertical wind-speed shear (see Equation (2-30))

The following parameters are source inputs required for use in the model:

Q = total source strength emitted along the length L of the line source

H = aircraft flight altitude above the ground

V_j = gravitational settling velocity for the median drop by mass in the j^{th} drop-size category

f_j = fraction of the total source strength in the j^{th} drop-size category

γ_j = reflection coefficient for the median drop by mass in the j^{th} drop-size category

σ_o = standard deviation of the cloud distribution at the distance x_R

L = length of the line source

As noted above, the vapor emitted from evaporating drops also contributes to the total dosage above the canopy. In the program construct, the evaporation model determines the mass of vapor emitted in Δh height units along the cloud axis as it descends to the canopy. The distance downwind from the line source where the vapor is emitted is given by $\bar{u}t$ where t is the time from the evaporation model when the cloud axis passes through the midpoint of the height interval Δh. The source dimension of the vapor cloud emitted over the Δh height interval is

$$\sigma_o = \frac{\Delta h}{\sqrt{12}} \qquad (2\text{-}21)$$

under the assumption that the vapor is rectangularly distributed at the point of emission. The vapor dosage is then calculated from Equation (2-1) with V_j set equal to zero, γ_j set to equal unity, and x_R set equal to $\bar{u}t$. Finally, the total dosage at the calculations point is determined in the program by summing the contributions from the drops and vapor clouds.

As inspection of Equation (2-1) and the definitions of the parameters appearing in Equation (2-1) show, the model cannot be used when the wind direction is exactly parallel to the line source (θ=90 degrees) or when the wind direction is exactly perpendicular to the line source (θ=0 degrees). For the case when θ=90 degrees, the program uses the

exact solution by making the following substitutions in Equation (2-1) through (2-19):

$$\left.\begin{aligned} \cot\theta &= 0 \\ \left(n - \frac{\delta}{\cos\theta}\right) &= y \\ \sin\theta &= 1 \end{aligned}\right\} \tag{2-22}$$

and defining x' as the downwind distance from the upwind edge of the line source and y as the crosswind distance from the line source. For the case when θ=0 degrees, the program also uses the exact solution

$$D_L = \frac{Q}{2\pi\,\sigma_y\,\sigma_z\,\bar{u}\,L}\,\{\text{Vertical Term}\}\,\{\text{Lateral Term}\} \tag{2-23}$$

The Vertical Term is

$$\begin{aligned} f_j \Bigg\{ &\sum_{i=0}^{\infty} \left[\gamma_j^{i} \exp\left[-\frac{1}{2}\left(\frac{2iH_m - H_j' + z + V_j x/\bar{u}}{\sigma_z}\right)^2\right] + \gamma_j^{i+1} \exp\left[-\frac{1}{2}\left(\frac{2iH_m + H_j' + z - V_j x/\bar{u}}{\sigma_z}\right)^2\right]\right] \\ &+ \sum_{i=1}^{\infty} \left[\gamma_j^{i} \exp\left[-\frac{1}{2}\left(\frac{2iH_m + H_j' - z - V_j x/\bar{u}}{\sigma_z}\right)^2\right] + \gamma_j^{i-1} \exp\left[-\frac{1}{2}\left(\frac{2iH_m - H_j' - z + V_j x/\bar{u}}{\sigma_z}\right)^2\right]\right] \Bigg\} \end{aligned} \tag{2-24}$$

where, for convenience, the quantity 0^0 is defined to be equal to unity.

The Lateral Term is

$$\frac{1}{2}\left[\operatorname{erf}\left(\frac{L/2 + y}{\sqrt{2}\,\sigma_y}\right) + \operatorname{erf}\left(\frac{L/2 - y}{\sqrt{2}\,\sigma_y}\right)\right] \tag{2-25}$$

In Equation (2-24), x is the downwind distance from the line source and in Equation (2-25), y is the crosswind distance from the center of the line source. In the program, the standard deviation of the crosswind distribution σ_y and of the vertical distribution σ_z are defined by the expressions

$$\sigma_y = \sigma'_A\,(x) + \sigma_o \tag{2-26}$$

$$\sigma_z = \frac{\sigma'_A}{k}\,(x) + \sigma_o \tag{2-27}$$

Peak Concentration Models

The peak concentration (mass per unit volume) which occurs at the calculation point is determined from the expression

$$\chi_{pL} = \frac{D_L\,\bar{u}}{\sqrt{2}\,\sigma_x} \tag{2-28}$$

where σ_x is the standard deviation of the cloud in the alongwind direction defined by

$$\sigma_x = \left[\left(\frac{L\{x\}}{4.3}\right)^2 + \sigma_o^{\,2}\right]^{1/2} \tag{2-29}$$

and

$L\{x\}$ = alongwind cloud length

$$= \frac{0.6\ \Delta\bar{u}}{\bar{u}} \left(x' - \frac{L \sin\theta}{2} \right) \qquad (2\text{-}30)$$

$\Delta\bar{u}$ = vertical wind-speed shear in the layer containing the cloud

The use of the peak concentration models requires that the meteorological parameter $\Delta\bar{u}$ be specified in the program input list.

Deposition Models

The deposition, expressed in units of mass per unit area, at the point (ε, δ, 0) downwind from line sources at an angle θ with the mean wind direction is given by the expression

$$\mathrm{Dep}_L = \frac{2S}{\sin\theta} \sum_{j=1}^{J} f_j\ (1-\gamma_j) \left\{ \frac{B \exp\left(\frac{G^2}{4F} - P\right)}{2F} \left[\exp\left[-\left(F^{1/2} \left(\frac{1}{a} - \frac{G}{2F} \right) \right)^2 \right] \right. \right.$$

$$- \exp\left[- \left(F^{1/2} \left(\frac{1}{b} - \frac{G}{2F} \right) \right)^2 \right] \Bigg] + \frac{G B \pi^{1/2} \exp\left(\frac{G^2}{4F} - P \right)}{4F^{3/2}} \qquad (2\text{-}31)$$

$$\left[\mathrm{erf}\left(F^{1/2} \left(\frac{1}{b} - \frac{G}{2F} \right) \right) - \mathrm{erf}\left(F^{1/2} \left(\frac{1}{a} - \frac{G}{2F} \right) \right) \right]$$

$$+ \sum_{i=1}^{\infty} \gamma_j^{\ i-1} \left\{ \frac{C \exp \frac{J^2}{4I} - P}{2I} \left[\exp\left[-\left(I^{1/2} \left(\frac{1}{a} - \frac{J}{2I} \right) \right)^2 \right] \right. \right.$$

(Equation (2-31) is continued) ...

$$- \exp\left[-\left(I^{1/2}\left(\frac{1}{b}-\frac{J}{2I}\right)\right)^2\right]\Bigg] + \frac{JC\pi^{1/2}\exp\left(\frac{J^2}{4I}-P\right)}{4I^{3/2}}$$

$$\left[\operatorname{erf}\left(I^{1/2}\left(\frac{1}{b}-\frac{J}{2I}\right)\right) - \operatorname{erf}\left(I^{1/2}\left(\frac{1}{a}-\frac{J}{2I}\right)\right)\right]$$

(2-31)
(Cont.)

$$+ \gamma_j \frac{D\exp\left(\frac{K^2}{4E}-P\right)}{2E}\left[\exp\left[-\left(E^{1/2}\left(\frac{1}{a}-\frac{K}{2E}\right)\right)^2\right] - \exp\left[-\left(E^{1/2}\left(\frac{1}{b}-\frac{K}{2E}\right)\right)^2\right]\right]$$

$$+ \gamma_j \frac{KD\pi^{1/2}\exp\left(\frac{K^2}{4E}-P\right)}{4E^{3/2}}\left[\operatorname{erf}\left(E^{1/2}\left(\frac{1}{b}-\frac{K}{2E}\right)\right) - \operatorname{erf}\left(E^{1/2}\left(\frac{1}{a}-\frac{K}{2E}\right)\right)\right]\Bigg\}\Bigg\}$$

$$B = H' + \frac{V_j x_V}{\bar{u}} \qquad (2\text{-}32)$$

$$G = \frac{2^{1/2}}{\sigma'_A}\left[\frac{V_j B k^2}{\bar{u}} + \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \qquad (2\text{-}33)$$

$$F = k^2B^2 + \left(n - \frac{\delta}{\cos\theta}\right)^2 \qquad (2\text{-}34)$$

$$J = \frac{-2^{1/2}}{\sigma'_A}\left[\frac{V_j C k^2}{\bar{u}} + \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \qquad (2\text{-}35)$$

$$I = k^2C^2 + \left(n - \frac{\delta}{\cos\theta}\right)^2 \tag{2-36}$$

$$K = \frac{2^{1/2}}{\sigma'_A}\left[\frac{V_j Dk^2}{\bar{u}} + \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \tag{2-37}$$

$$E = k^2d^2 + \left(n - \frac{\delta}{\cos\theta}\right)^2 \tag{2-38}$$

and the remaining parameters, except a and b, are identical to those defined for the dosage model. The definitions of a and b for the dosage model given by Equations (2-14) and (2-15) are reversed in the case of the deposition model, *i.e.*,

$$a = 2^{1/2} \quad \sigma'_A\left(x' + x_V\right) \tag{2-39}$$

$$b = 2^{1/2} \quad \sigma'_A\left(x' + x_V - \ell\sin\theta\right) \tag{2-40}$$

The deposition model that applies when the wind direction is exactly parallel to the line source can be obtained from Equations (2-31) through (2-38) using the substitutions defined by Equation (2-22). Deposition for the case when the wind is exactly perpendicular to the line source is given by the expression

$$\text{Deposition} = \sum_{j=1}^{J} \frac{f_j \; Q(1-\gamma_j)}{2\pi \; \sigma_y \; \sigma_z (x+x_V)} \; \{\text{Vertical Term}\} \; \{\text{Lateral Term}\} \tag{2-41}$$

where the Vertical Term is

$$\left\{\left[H'_j + \frac{V_j x_v}{\bar{u}}\right]\left[\exp\left(-\frac{1}{2}\left(\frac{H'_j - V_j\ x/\bar{u}}{\sigma_z}\right)^2\right)\right]\right.$$

$$+\sum_{i=1}^{\infty}\gamma_j^{\,i-1}\left\{\left[2i\ H_m - H'_j - \frac{V_j x_V}{\bar{u}}\right]\left[\exp\left(-\frac{1}{2}\left(\frac{2i\ H_m - H'_j + V_j\ x/\bar{u}}{\sigma_z}\right)^2\right)\right]\right. \tag{2-42}$$

$$\left.\left.+\ \gamma_j\left[2iH_m + H'_j + \frac{V_j x_V}{\bar{u}}\right]\left[\exp\left(-\frac{1}{2}\left(\frac{2i\ H_m - H'_j + V_j\ x/\bar{u}}{\sigma_z}\right)^2\right)\right]\right\}\right\}$$

As before, 0^0 is defined to be equal to unity and x is the downwind distance from the source. The Lateral Term in Equation (2-41) is defined by Equation (2-25) where y is the crosswind distance from the center of the line source and σ_y and σ_z are defined, respectively, by Equations (2-26) and (2-27). (2-27).

2.2 EVAPORATION MODEL

The FSCBG computer program has a number of options allowing the user to account for the effects of the evaporation of drops in the calculation of dosage, concentration and deposition. The first step in the calculation of evaporation effects is the specification of the time-rate change of the drop diameter for the initial j drop-size categories. The program user has the option of selecting an automated procedure for the theoretical calculation of the time-rate change in drop diameter, or of supplying values of the constants A, B and C in the quadratic equation

$$D_j = A_j + B_j t + C_j t^2 \tag{2-43}$$

specifying the change of drop diameter with time t after release.

The theoretical calculation of the time-rate change of drop diameter in the FSCBG program is based on the expression

$$D_{f,j} = D_{i,j} + \frac{dD}{dt} \Delta t \qquad (2\text{-}44)$$

where

$D_{f,j}$ = final diameter of the median drop in the j^{th} drop-size category after the time increment Δt

$D_{i,j}$ = initial diameter of the median drop in the j^{th} drop-size category

Frössling (see Fuchs, 1959, p. 44) defines the change in diameter of water drops due to evaporation by

$$\frac{d\,D_j}{dt} = \frac{(4\text{x}10^8)\ M_\ell\ D_v\ \rho_A\ (e_s - e_\infty)}{M_m\ D_j\ \rho_\ell\ (P_A - e_s)}\ \bar{f}_v \qquad (2\text{-}45)$$

where

M_ℓ = molecular weight of evaporating vapor from the drop (g mol^{-1})

M_m = mean molecular weight of the resulting vapor-air mixture in the transfer path which is approximated by that of air (M_A) in the FSCBG program (g mol^{-1})

D_v = molecular diffusivity of the evaporating vapor in air at the drop temperature ($\text{cm}^2\ \text{s}^{-1}$)

D_j = drop diameter (μm)

ρ_A = air density (g cm^{-3})

ρ_ℓ = density of the liquid drop (g cm^{-3})

e_s = partial pressure of the evaporating vapor at the drop surface (mb)

e_∞ = partial pressure of the evaporating vapor at an infinite distance from the drop (mb)

P_A = air pressure (mb)

$\bar{f}_v$ = ventilation factor (dimensionless)

The air density in the model is calculated from the relationship

$$\rho_a = \frac{P_A M_A}{R^* T_V} \left(10^{-4}\right) \tag{2-46}$$

where R* is the universal gas constant (8.31432 j mole^{-1} $^oK^{-1}$) and T_V is given in terms of the mixing ratio r_∞. According to Beard and Pruppacher (1971),

$$T_V = T_A \left(1 + \frac{r_\infty}{0.62197}\right) \Big/ (1+r_\infty) \tag{2-47}$$

where

T_A = air temperature (^oK)

$$r_\infty = 0.62197\ e_\infty / (P_A - e_\infty) \tag{2-48}$$

The diffusivity D_v of the vapor into air at the temperature of the surface of the drop T_r depends on the liquid being considered. For water drops, the FSCBG program uses the expression (Pruppacher and Rasmussen, 1979)

$$D_v = 0.211 \left[\frac{T_r}{T_o}\right]^{1.94} \left[\frac{P_o}{P_A}\right] \tag{2-49}$$

where T_o is 273.16 ^oK, P_o is 1013.25 mb and T_r is determined from the relation

$$T_r = T_A - \frac{L\ D_v\ M_\ell\ (e_s - e_\infty)}{k\ R^*\ T_f} \tag{2-50}$$

where

L = latent heat of vaporization (cal g^{-1})

$$= 597.3 \left[\frac{T_o}{T_r}\right]^\alpha \tag{2-51}$$

$$\alpha = 0.107 + 3.67 \times 10^{-4}\ T_r \tag{2-52}$$

k = thermal conductivity (cal cm^{-1} s^{-1} $^oK^{-1}$) (2-53)

$$= k_d\left[1 - (1.17 - 1.02\ k_v/k_d)(e_\infty/P_A)\right] \tag{2-53}$$

$$k_d = 10^{-5}\left[5.69 - 0.017\ (T_r - T_o)\right] \tag{2-54}$$

$$k_v = 10^{-5}\left[3.78 - 0.020\ (T_r - T_o)\right] \tag{2-55}$$

$$T_f = (T_r + T_A)/2 \tag{2-56}$$

The partial pressure e_s is defined by the expression

$$e_s = \beta\left[\frac{575.0466 + 31.82291\ T_i + 1.296028\ T_i^2}{93.51611 - T_i}\right] \tag{2-57}$$

where

$$T_i = T_r - T_o \tag{2-58}$$

and

$$\beta = 1 \tag{2-59}$$

The vapor pressure at e_∞ is also obtained from Equation (2-57) when T_r is replaced by T_A in Equation (2-58) and β is replaced by (RH/100), where RH is the relative humidity in percent. To find the drop temperature, vapor pressure at the drop surface and diffusivity, Equations (2-49) through (2-57) are solved by iteration in the FSCBG program.

The ventilation factor $\bar{f}_v$ for water is given by (Pruppacher and Rasmussen, 1979)

$$\bar{f}_v = \begin{cases} 0.78 + 0.308\ Sc^{1/3}\ Re^{1/2} & 1.4 < Sc^{1/3}\ Re^{1/2} \leq 51.4 \\ 1.00 + 1.108\ Sc^{1/3}\ Re^{1/2} & 0 \leq Sc^{1/3}\ Re^{1/2} \leq 1.4 \end{cases} \tag{2-60}$$

where

Re = Reynolds number

$$= \frac{V_j\ D_j\ \rho_A}{\mu_A} \left(10^{-4}\right) \tag{2-61}$$

Sc = Schmidt number

$$= \frac{\mu_A}{D_v\ \rho_A} \tag{2-62}$$

μ_A = absolute viscosity of air (g cm^{-1} s^{-1})

$$= \frac{(7.6342 \times 10^{-2})}{(T_A + 296.16)} \left(\frac{T_A}{296.16}\right)^{3/2} \tag{2-63}$$

The user can, on option, ask the FSCBG program to theoretically determine the time-rate change of drop diameter for non-water drops.

However, additional information is required by the program. When this option is selected, the drop temperature and vapor pressure at the drop are automatically calculated from the expression (Picot, 1979)

$$A \exp\left(B - C/T_r\right) - e_s = \left(\frac{k}{C_f\, D_v\, L}\right)\left(T_A - T_r\right)\left[P_A - A \exp\left(B - C/T_r\right)\right] \quad (2\text{-}64)$$

where

$A = P_o/760$

C_f = molal concentration of the liquid (mol cm^{-3})

k = thermal conductivity of the gas mixture surrounding the drops at the drop surface temperature

B, C = constants obtained from tables expressing variations of vapor pressure with temperature (see, for example, page D-140, Handbook of Chemistry, 58th Edition, published by Chemical Rubber Co.)

Values of k, D_v and L for non-water drops must also be specified by the program user. The value of e_∞ for non-water drops can probably be set equal to zero. When the parameters required by Equation (2-64) have been specified, the program uses Newton's iteration procedures to determine the drop temperature and vapor pressure and the time-rate change of diameter, using the following expression (Fuchs, 1959) for the ventilation coefficient

$$\bar{f}_v = \frac{1}{2}\,\mathrm{Sh} \quad (2\text{-}65)$$

where

$$\begin{aligned} \mathrm{Sh} &= \text{Sherwood number} \\ &= 2\left(1 + \alpha\, \mathrm{Sc}^{1/3}\, \mathrm{Re}^{1/2}\right) \quad (2\text{-}66) \end{aligned}$$

and α is set equal to 0.3 in the FSCBG program as suggested by Picot (1979).

Finally, for both water and non-water drops, the results obtained using the evaporation model for above canopy calculations are fitted with Equation (2-43) by least-squares over the time period required for the drop to evaporate to a diameter of 5 micrometers or the settling velocity to reach 0.02 $m\,s^{-1}$, whichever is greater. For calculations of evaporation effects below the canopy, Equation (2-43) is fitted to the evaporation model results over the time period required for the drop to travel from the top of the canopy to the ground.

The following parameters required by the evaporation model are based on meteorological measurements:

T_A = air temperature

P_A = air pressure

RH = relative humidity (for water drops)

The following parameters are source inputs required by the evaporation model:

M_ℓ = molecular weight of evaporating vapor

ρ_ℓ = density of the liquid for non-water drops

2.3 CANOPY PENETRATION MODEL

Grim and Barry (1975) developed a mathematical model to calculate the percentage material of a given drop-size category j which, after entering the forest at the top of the canopy, is retained at various levels within the canopy. The model is based on a Monte Carlo technique where a large number of drops in each size category are passed along a trajectory

through a simulated forest with trees assigned to equal areas according to the density (stems per acre) in the forest being simulated. The drop trajectory is a function of the gravitational settling velocity V_j, which varies along the trajectory when the evaporation model is used, and the mean wind speed at various levels within the canopy. As a drop proceeds along the trajectory, each tree is randomly displaced within the assigned area in the plane of the horizon and calculations are made to determine if the drop intersects the tree envelope and, if an intersection occurs, whether the drop strikes a tree element. When the drop strikes a tree element, a tally is recorded for the height interval within the canopy where the "hit" occurs and for all greater height intervals. Drops proceed along the trajectory until a hit occurs or until the trajectory intersects the ground. After the specified total number of drops in the size category have passed along the trajectory, the tally number within each height interval is divided by the total number of drops to obtain the percentage of drops reaching the given height interval. The total number of drops passed along the trajectory required to achieve a stabilized solution (percentage penetration) is a function of the steepness of the trajectory, with more drops being required for size categories with large settling velocities. In the FSCBG program, 500 drops in each size category are passed along the trajectory.

Figure 2-2 is a schematic diagram showing an example drop trajectory and forest construct. The drop trajectory in each of k height intervals is defined by the following piecewise linear function:

$$x_k = \left\{ \begin{array}{ll} 0 & ; \quad k=0 \\ \\ \dfrac{0.25\ (k-1)\ H_c}{\tan \phi_k} + x_{k-1} & ; \quad k=1,\ 2,\ 3,\ 4 \end{array} \right\} \tag{2-67}$$

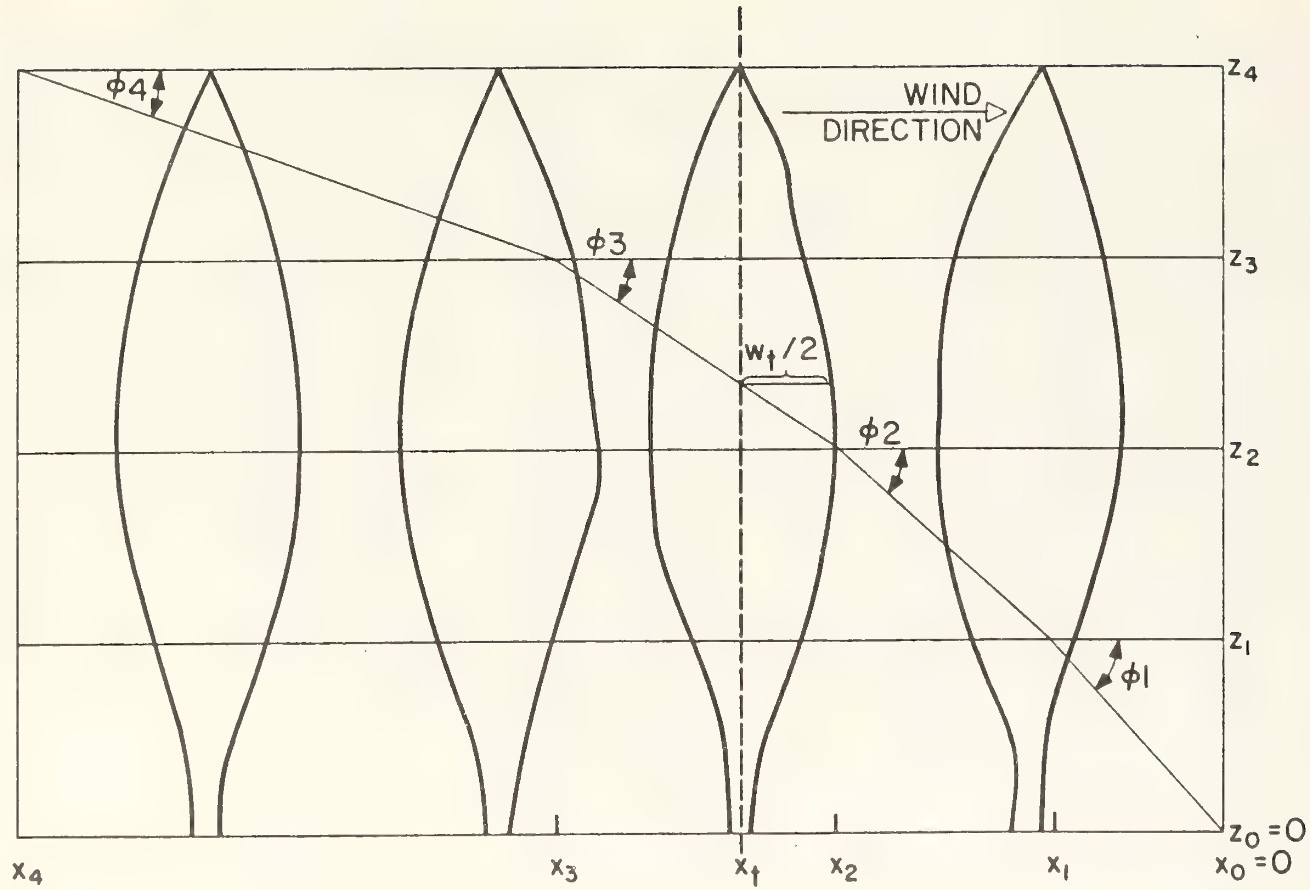

FIGURE 2-2. Schematic diagram showing an example drop trajectory and simulated forest.

$$y_k = 0 \tag{2-68}$$

$$z_k = 0.25kH_c \quad ; \quad k = 0, 1, 2, 3, 4 \tag{2-69}$$

where

ϕ_k = angle, measured in radians, defining the declination of the trajectory with respect to the plane of the horizon

$$= \begin{cases} \tan^{-1} \dfrac{V_j}{\bar{u}_{c;k}} & ; \quad \phi \leq 1.4 \text{ radians} \\ \\ 1.4 \text{ radians} & ; \quad \phi \geq 1.4 \text{ radians} \end{cases} \tag{2-70}$$

H_c = height of the forest canopy

$\bar{u}_{c;k}$ = mean wind speed in the k^{th} height interval within the canopy

In Figure 2-2 the trajectory is shown as a linear function in each height interval. When the evaporation model is used, the trajectory is curvilinear in each height interval. The number of trees placed along the trajectory path in the simulated forest is given by the expression

$$N_T = x_4/\Delta x_t \tag{2-71}$$

where

x_4 = maximum horizontal travel distance in meters of the drop within the forest canopy

Δx_t = alongwind tree spacing within the simulated forest

$$= 63.615/\sqrt{D_t} \tag{2-72}$$

D_t = tree density in units of stems per acre

As shown in Figure 2-3, each tree stem is given the following location along the trajectory:

$$x_t = (N_t - n)\,\Delta x_t + (R - 0.5)\,\Delta x_t \quad ; \quad n=1, 2, \ldots\ldots N_t \qquad (2\text{-}73)$$

$$y_t = \left|(R' - 0.5)\,\Delta x_t\right| \qquad (2\text{-}74)$$

where

n = tree number

and R and R' are uniform random numbers between 0 and 1. The possibility of the drop trajectory intersecting the tree envelope is determined by comparing the distance y_t with the radius of the tree envelope $(W_t/2)$ at the height z_p where the trajectory passes through the distance x_t. The tree widths W_t are specified by the program user at one-meter intervals and the program calculates the radius $(W_t/2)$ at z_p by linear interpolation. If y_t is greater than $(W_t/2)$, no intersection occurs and the computer program proceeds to the next tree along the trajectory.

If the drop trajectory intersects the tree envelope, the program calculates the probability that the drop impacts on a tree element from the expression

$$P_j = E_j(1 - \mathrm{PRPEN}^{\zeta}) \qquad (2\text{-}75)$$

where

E_j = impaction efficiency of the tree element for the j^{th} drop-size category

PRPEN = probability of penetration for the population of drops and for a horizontal trajectory through the tree

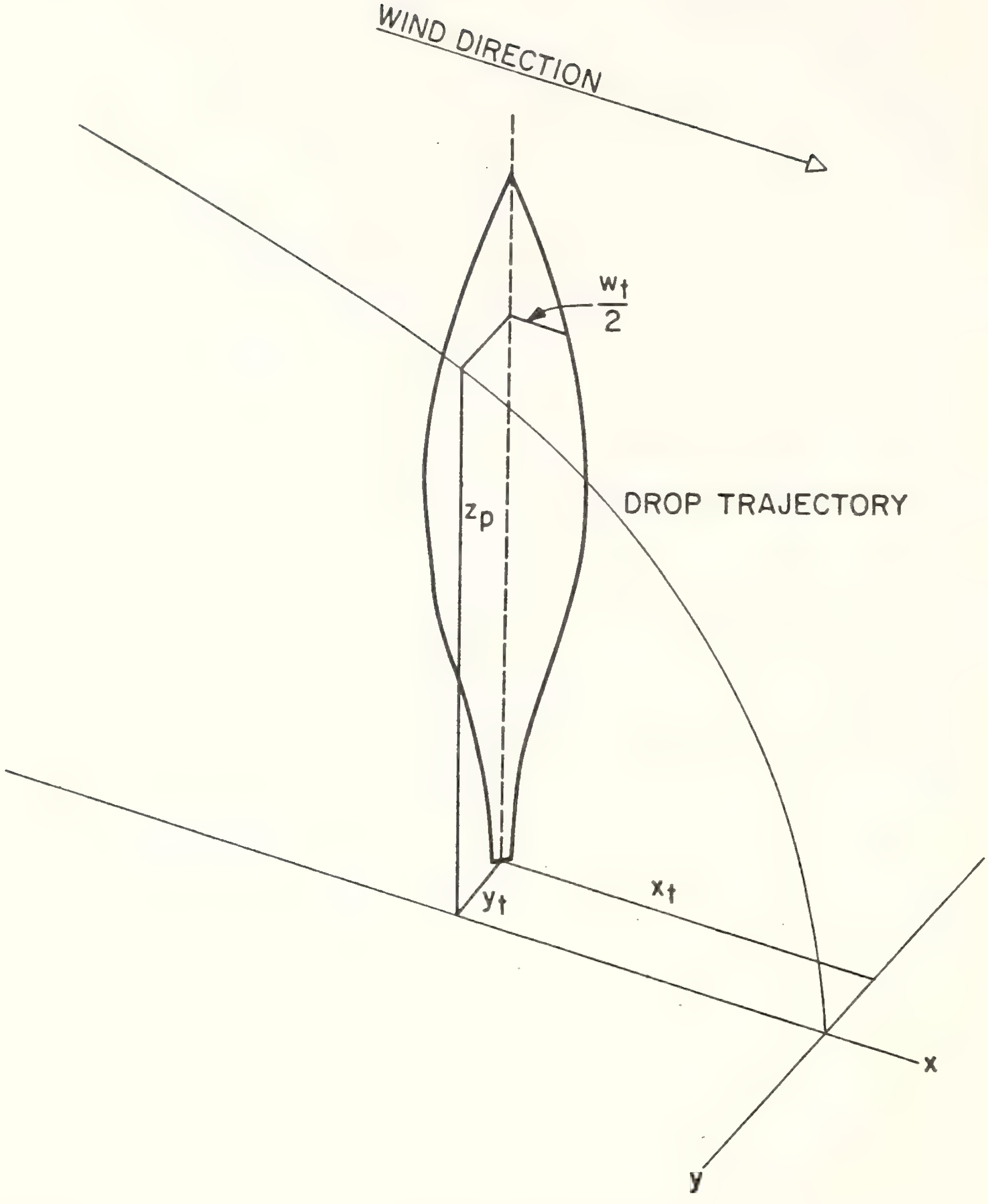

FIGURE 2-3. Schematic diagram showing the coordinate location of the "random tree".

ζ = path length correction factor for a non-horizontal trajectory

$$= \left\{ \begin{array}{ll} \dfrac{1}{\cos \phi_k} & ; \quad \zeta \leq \dfrac{H_c}{W_m} \\ \\ \dfrac{H_c}{W_m} & ; \quad \zeta > \dfrac{H_c}{W_m} \end{array} \right\} \tag{2-76}$$

W_m = maximum width of the tree envelope

In the FSCBG computer program, the user has the option of entering the impaction efficiency E_j for each drop-size category or permitting the program to calculate E_j from the following empirical relationship, recommended by Grim and Barry (1975) and attributed to Sell:

$$E_j = \left\{ \begin{array}{ll} \dfrac{2.84 \times 10^4 \, D_j^2 \, v}{s} & ; \quad E_j \leq 1 \\ \\ 1 & ; \quad E_j > 1 \end{array} \right\} \tag{2-77}$$

where

v = impaction velocity (ms^{-1})

$$= \left[(\bar{u}_{c;k})^2 + V_j^{\,2} \right]^{1/2} \tag{2-78}$$

s = diameter of the element on which the drop impacts (cm)

A particular drop of the population of drops is assumed to intersect the tree element when the value of P_j from Equation (2-75) is greater than a uniform random number R between 0 and 1. Each tree is divided into ten height-class intervals, and an intersection with a tree element is recorded as a "hit" in the class interval in which z_p occurs and in every higher class interval.

The process described above is repeated for every drop passed along the trajectory and the final percentage of material penetrating to a given height interval determined by dividing the number of recorded hits in the height interval by the total number of drops in all j^{th} size categories passed along the trajectory. When the evaporation model is used, the mass or number of drops reaching a given level in the canopy is further adjusted to account for losses due to evaporation.

The inputs required by the canopy penetration model are:

PRPEN = probability of penetration

$\bar{u}_{c;k}$ = mean wind speed in the k^{th} height interval within the forest canopy

D_t = tree density in stems per acre

H_c = tree height in meters

W_i = tree width at one-meter height intervals

The computer program also permits the user to simulate a multi-storied canopy of up to three tree heights, with a different value of PRPEN possible for each tree or story height. The authors vary the values of PRPEN as a function of the four foliage types illustrated in Figure 2-4.

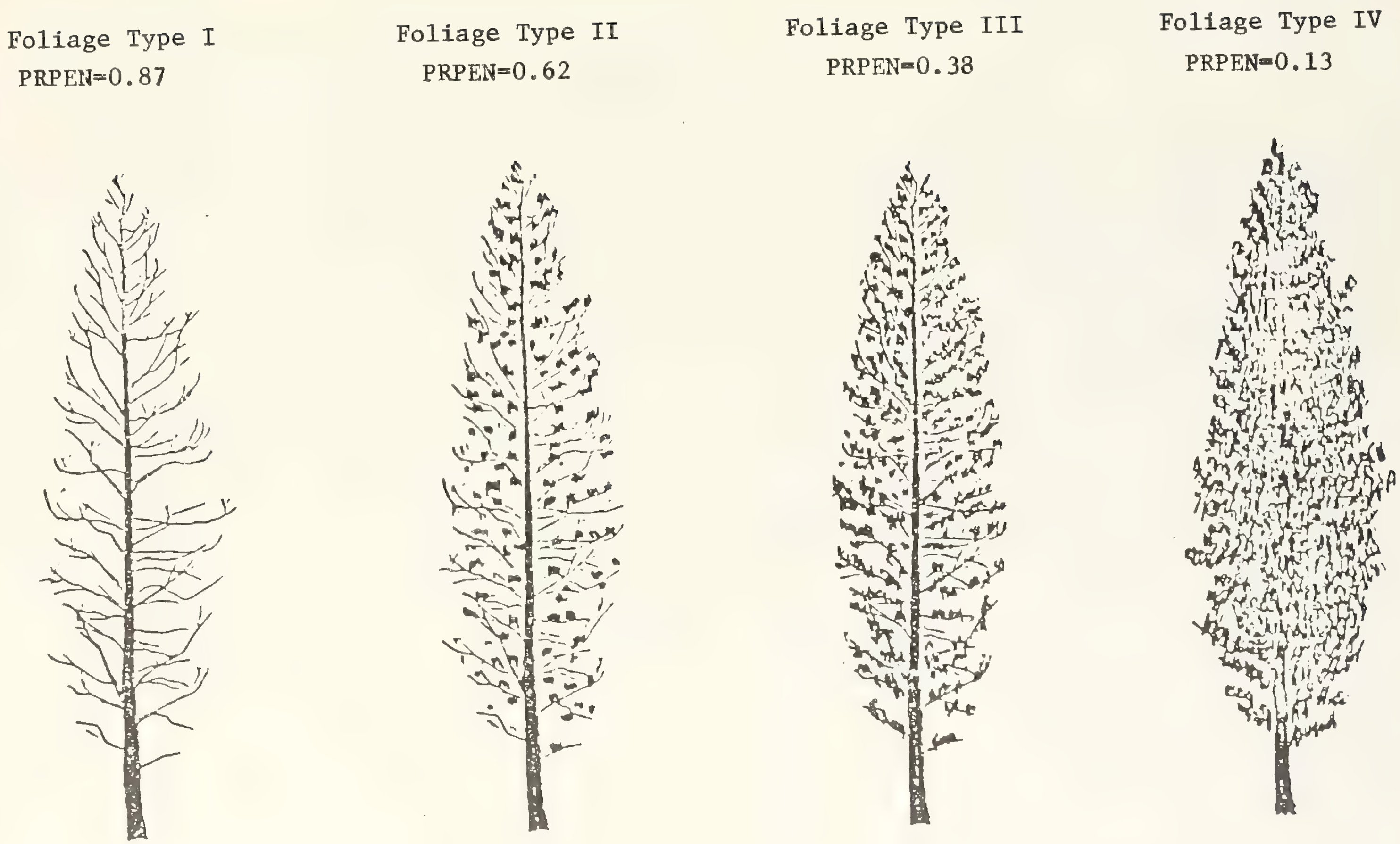

FIGURE 2-4. Diagram illustrating four foliage types suggested for use in classifying forests (after Grim and Barry, 1975).

The output from the canopy penetration model includes, in addition to the percentage of material in the j^{th} drop size category penetrating to each of ten levels within the canopy, the maximum horizontal travel distance of the drop within the forest canopy (x_4). When the deposition models described in Section 2.1 are used in conjunction with the canopy penetration model to calculate deposition within the canopy, the distance from the line source to the target is adjusted so that the deposition model calculates the deposition at the top of the forest canopy at a distance x_4 upwind from the target. The deposition at the target is then determined by multiplying the deposition calculated from the deposition models in Section 2.1 by the percentage of material reaching the calculation height from the canopy penetration model.

2.4 AIRCRAFT WAKE MODEL (WAKE SETTLING VELOCITY MODEL)

During a short time period after spray is released from an aircraft, the vortices formed by the wings and propellers of fixed-wing aircraft and by helicopter rotors principally control the growth of the spray cloud. Except for the lateral translation of the vortex system by a crosswind, the vortices also control the position in space of the spray cloud and the amount of material which may be deposited on the underlying surface directly below the flight path. There are a number of sophisticated models presented in the literature describing conventional aircraft wake action (C. duP. Donaldson and A. J. Bilanin, 1975) and associated computer programs (Hirsh, 1978). Wickens (1977) has used numerical simulation models which neglect atmospheric diffusion to describe the effects of aircraft wake vortices on aerial spray deposition. Currently, the USFS is cosponsoring an effort with the National Aeronautics and Space Administration (NASA) to further investigate wake effects on spray deposition (Eckblad, 1980).

The relatively complex wake model programs currently available would, if incorporated with the dispersion evaporation and canopy penetration

codes in the FSCBG program, greatly increase the computation time required to estimate deposition patterns. From discussions with USFS personnel and others involved in the USFS-NASA program on wake effects, it appeared that simpler wake models and computer codes may soon be available. For these reasons, the FSCBG program has been designed so that wake computer codes can easily be modified and/or added to the program. Since the importance of wake effects was recognized, the version of the FSCBG code described in this report contains an interim wake-effects model we have found useful in previous work (Dumbauld, Rafferty and Bjorklund, 1977).

Prandtl and Tietjens (1934) express the sink rate ω (m s^{-1}) of a vortex system as

$$\omega = \frac{8g\ W_a}{\pi^3\ \rho_A\ b^2\ V_a}\left(10^{-3}\right) \tag{2-79}$$

where

W_a = weight of the aircraft (kg)

g = accelleration due to gravity (9.8 m s^{-2})

ρ_A = air density (g cm^{-3})

b = aircraft wing span (m)

V_a = aircraft speed (m s^{-1})

Equation (2-79) is strictly applicable to fixed-wing aircraft. However, as pointed out by the Bell Helicopter Company (1966 and updates), helicopter-produced vortices resemble fixed-wing vortices at high forward speeds.

In the spray dispersion models described in Section 2.1 above, the source parameters correspond to the spray cloud properties when the cloud has reached approximate atmospheric equilibrium. The vortex sink rate

calculated from Equation (2-79) and the observations that the vortex tube stops descending at a distance (b/2) above the surface (Jones, 1970) or above the forest canopy are used to calculate source parameters for the models. Figure 2-5 is a schematic diagram showing the geometrical considerations used in specifying the distance downwind x_R at which cloud stabilization occurs and the effective release height H'_j. As shown in Figure 2-5, the cloud descent from the aircraft at height H forms the angle $\tan^{-1}(\omega/\bar{u})$ with the horizontal when the gravitational settling velocity for the j^{th} drop-size category at height $H(V_{j;H})$ is less than ω. In general, the FSCBG program calculates the distance downwind from the flight path where the cloud reaches a height b/2 above the surface from the expression

$$x_R = \bar{u}\ t'_j \tag{2-80}$$

where

t'_j = effective time for the cloud centroid to reach the height b/2

$$= \left\{ \begin{array}{lll} (H - (b/2) - H_c) / \omega & ; & \omega \geq V_{j;H} \\ & & \\ t_{j;b/2} & ; & \omega \leq V_{j;H} \end{array} \right\} \tag{2-81}$$

$V_{j;H}$ = gravitational settling velocity for the j^{th} drop-size category at the aircraft flight altitude

$t_{j;b/2}$ = time for the drop in the j^{th} category to reach the height b/2 above the ground or canopy, calculated from the evaporation model

As noted in Section 2.1, the dispersion models are formulated under the assumption that the cloud axis descends at an angle $\tan^{-1}(V_j/\bar{u})$ with the

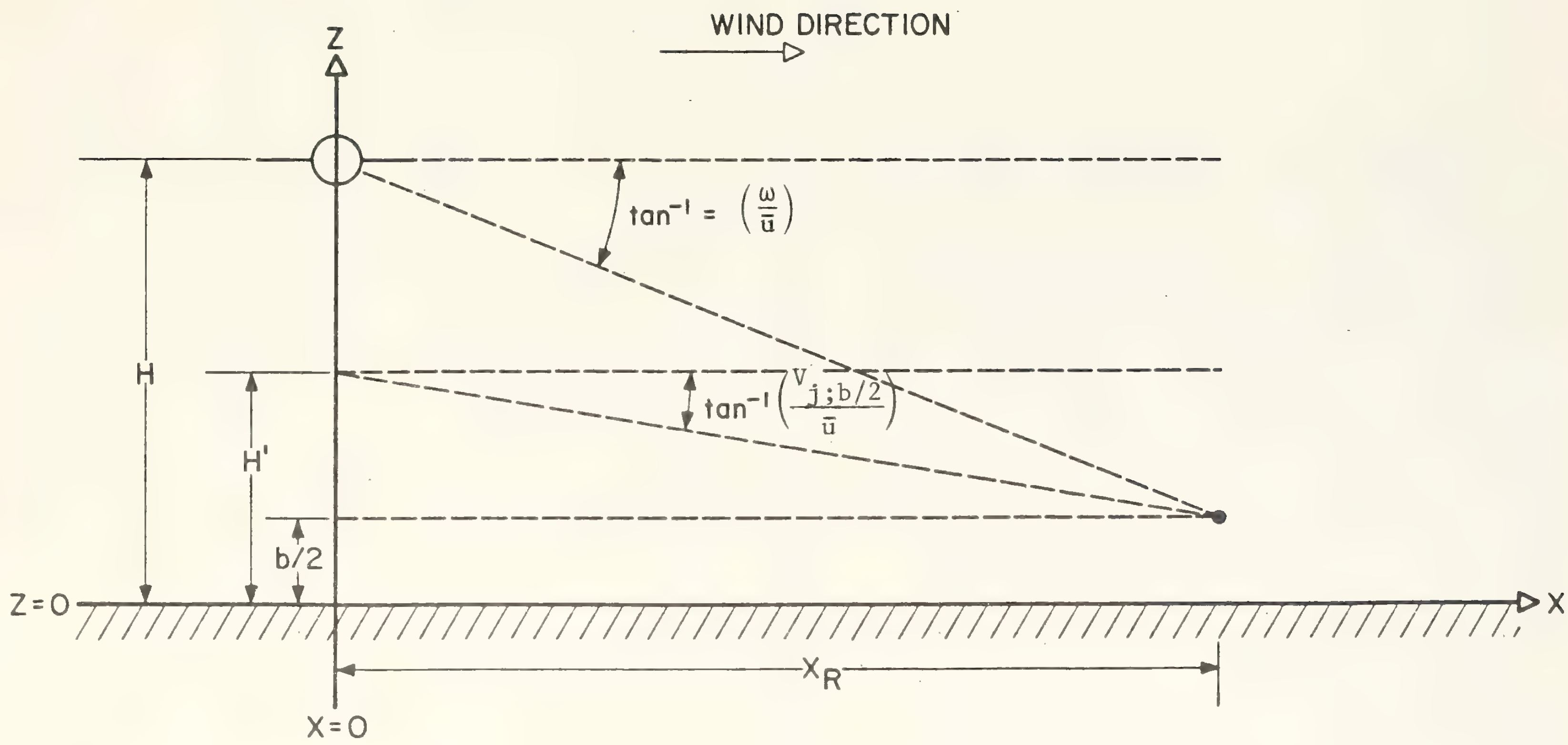

FIGURE 2-5. Schematic diagram showing geometry used in constructing the distance x_R and effective source height H' for the case when the settling velocity in the j^{th} size category at height H ($V_{j;H}$) is less than ω.

horizontal. We have therefore assumed that the effective declination of the cloud axis downwind from an effective source height H'_j is given by the angle $\tan^{-1}(V_{j;b/2}/\bar{u})$, where $V_{j;b/2}$ is the gravitational settling velocity calculated by the program for the drop at the height b/2. Based on this assumption, the effective release height H'_j is

$$H'_j = H_c + (b/2) + t'_j V_{j;b/2} \tag{2-82}$$

All gravitational settling velocities are calculated in the FSCBG program using a technique suggested by McDonald (1960). The graph given by McDonald expressing the relationship between the drag coefficient of spheres and their Reynolds number, has been fitted for Reynolds numbers less than $2x10^5$ and is used in the FSCBG program.

2.5 ADJUSTMENTS OF DEPOSITION CALCULATIONS FOR EVAPORATION

When no evaporation occurs, the calculation of deposition using Equations (2-31) through (2-32) is relatively straightforward because the gravitational settling velocity is invariant with time. However, when evaporation occurs both drop size and gravitational velocity vary with travel distance from the source and the deposition calculations become more complicated. To illustrate the procedures used by the computer program to calculate deposition with evaporation occurring, assume that we wish to calculate ground-level deposition for the j^{th} drop-size category at a distance of 75 meters downwind from an aircraft release at a height of 18.1 meters above the ground. The top of the canopy is at a height of 12 meters above the ground. The program follows the stepwise procedure outlined below.

(1) The program uses the above-canopy evaporation model described in Section 2.2 to establish a curve relating the

gravitational settling velocity (V_j) of the median drop in the j^{th} size category as a function of travel distance (x) from the source for above-canopy meteorology. A typical curve (for drop-size category 9 of the example problem explained in Section 4 and a relative humidity of 50 percent) is shown in Figure 2-6.

(2) The above-canopy evaporation model is also used to calculate the height trajectory of the drop as a function of travel distance. The curve for drop-size category 9 in the example problem for 50-percent humidity is shown in Figure 2-7. Note that the curve extends to negative heights because a drop in this category would have fallen this distance except for the effects of vertical dispersion above the canopy.

(3) The below-canopy evaporation model is used to calculate the trajectory of the drop in the j^{th} size category, using below-canopy meteorology and assuming that the drop entered the canopy with the settling velocity V_{jc} given by the above-canopy evaporation model at the canopy height. In addition to calculating the mass loss within the canopy, the below-canopy evaporation model calculates the travel distance (DISTM) of the drop from the time it enters the canopy until it strikes the ground.

(4) The program internally develops a curve relating the difference between the receptor distance from the source and the travel distance in the canopy $(X\text{-}DISTM)_j$ for all the drop-size categories versus the settling velocity at the canopy top V_{jc} for each j^{th} category. The curve for our example is shown by the nearly vertical line in Figure

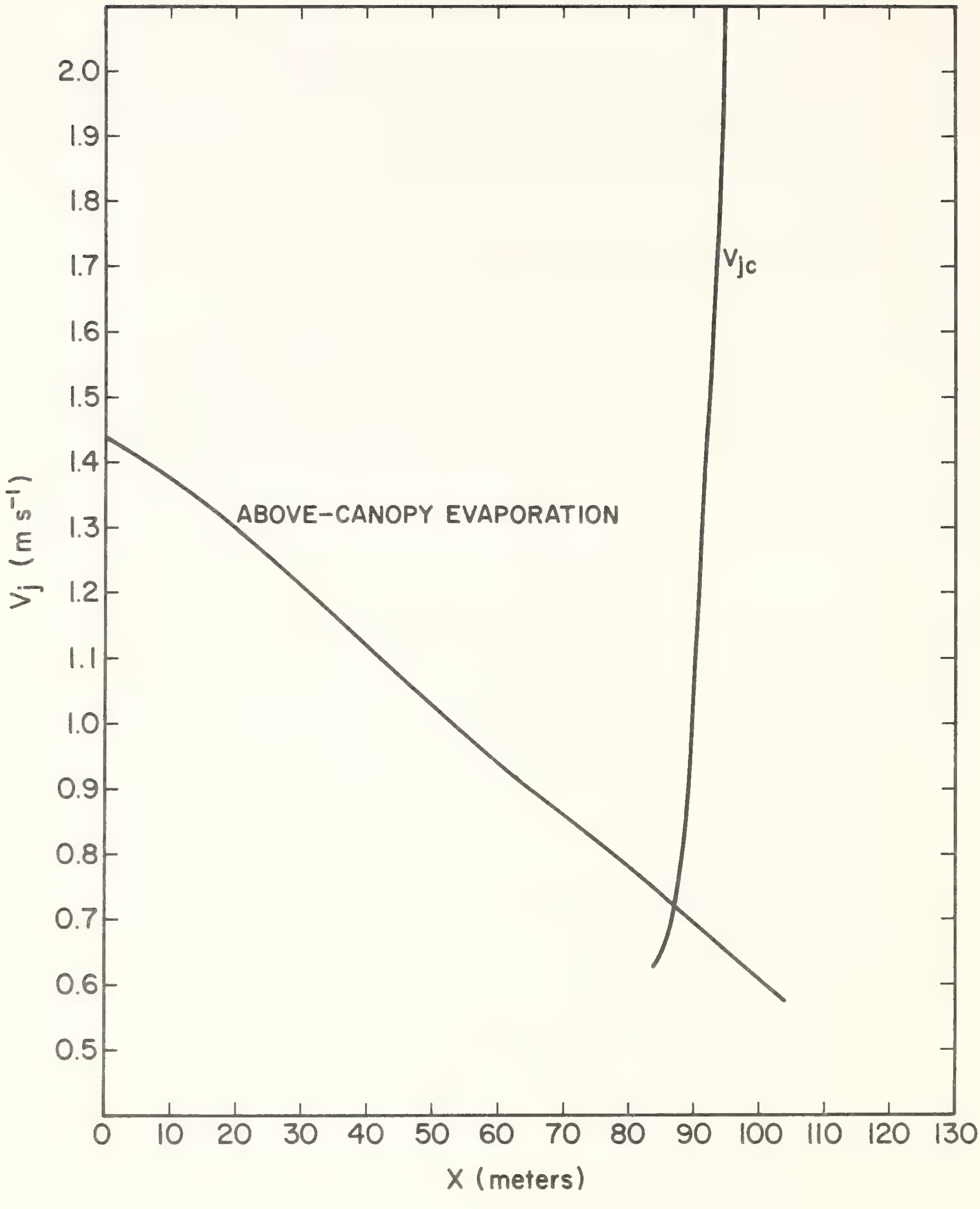

FIGURE 2-6. Gravitational settling velocity V_j versus distance from the source (see Section 2.5).

2-6, where the quantity $(X\text{-}DISTM)_j$ is plotted as X and V_{jc} is plotted as V_j.

(5) The intersection of the curve developed in step (4) above and the above-canopy evaporation curve for drop-size category 9 shown in Figure 2-6 defines the distance from the source to the point where a drop in size category 9 would have to enter the canopy in order to reach the vicinity of our receptor at a distance of 100 meters from the source. Thus, for our example, the drop in size category 9 would enter the canopy at a distance of 87 meters downwind from the source.

(6) The effective height H" of the cloud centroid for size category 9 at a distance of 87 meters from the source is obtained from the height versus distance curve shown in Figure 2-7. For our example, Figure 2-7 shows that H" is about -74 meters.

(7) The deposition model equations yield the corrected deposition values when an effective value of V_j is used in solving Equation (2-31) through Equation (2-42). Thus, the effective value of the gravitational settling velocity is

$$V_j = \frac{\bar{u}(H'_j - H'')}{x}$$

where H'_j is given by Equation (2-82) and, for our example, x is 87 meters and H" is -74 meters.

The calculations then proceed in the usual fashion except for appropriate adjustments for mass loss due to evaporation.

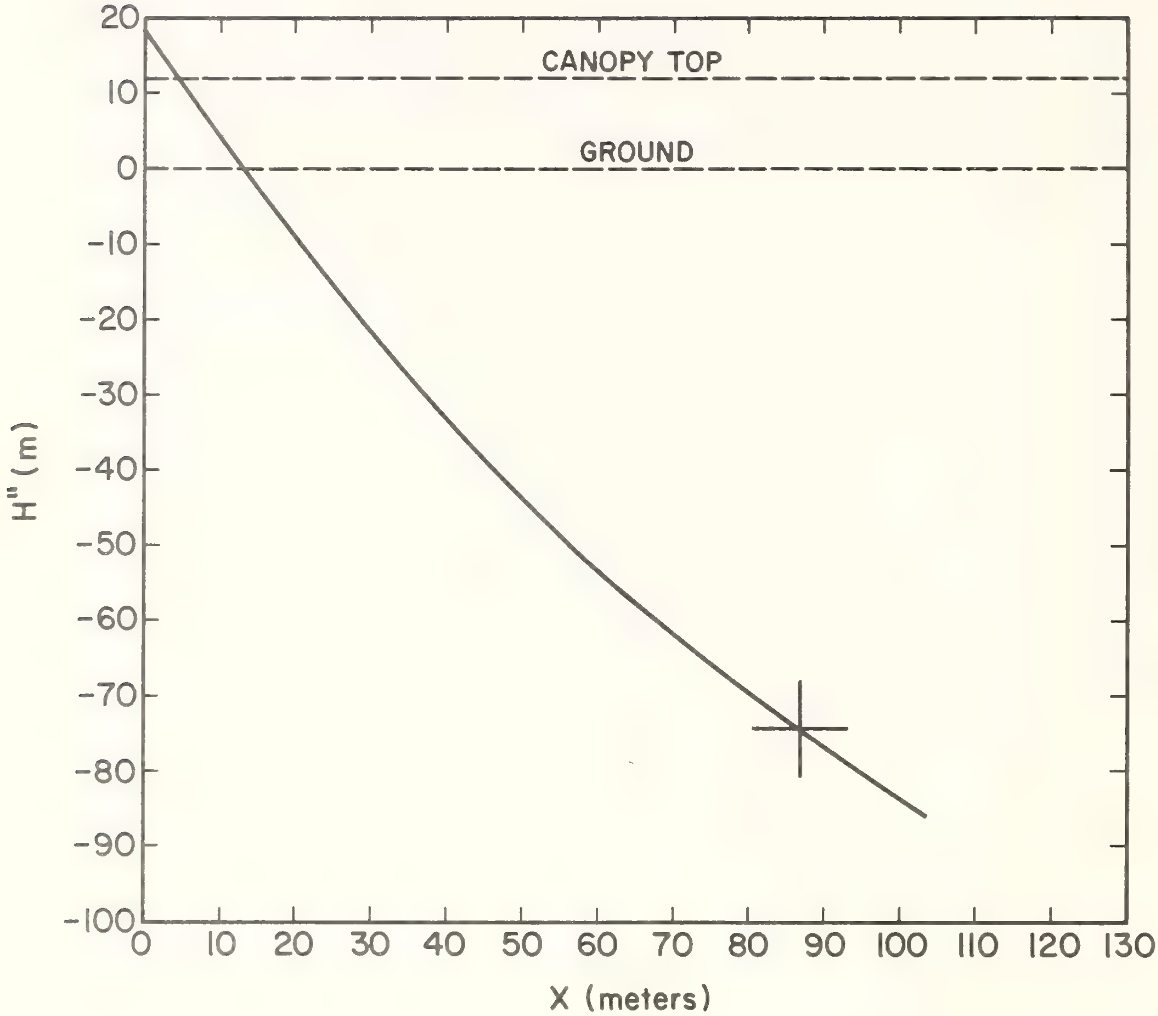

FIGURE 2-7. Height of drop in size category 9 versus distance from the source (see Section 2.5).

SECTION 3

USERS INSTRUCTIONS FOR THE FSCBG COMPUTER PROGRAM

3.1 SUMMARY OF PROGRAM MODEL OPTIONS, DATA REQUIREMENTS AND OUTPUT

3.1.1 Summary of FSCBG Program Model Options

The program model options of the FSCBG computer program consists of four general categories:

- Wake-Settling Velocity Model
- Drop Evaporation Model
- Canopy Penetration Model
- Dispersion Models

Each category is discussed separately below.

Wake-Settling Velocity Model. The FSCBG computer program provides the option of allowing the user to input the wake-settling velocity or allowing the FSCGB program to calculate the wake-settling velocity, providing the user inputs the weight of the aircraft, the ground speed of the aircraft and the wing span of the aircraft or helicopter rotor diameter.

Drop Evaporation Model. The FSCBG program requires the user to input the spray drop-size distribution. The other program models use these data with or without drop-size changes due to evaporation. If the user chooses to use the drop-size distribution without changes due to evaporation, the drop size as well as all related drop information (settling velocity, etc.) is assumed to be constant with time. However, if the user chooses to apply evaporation to the drop distribution, the program will determine the rate of change of the drop size as well as all related drop information (settling velocity, etc.) as a function of time. If desired, the FSCBG

program permits the user to specify the rate of change of drop size for each drop-size category as a function of time. If this option is chosen, the program requires the user to specify, for each drop-size category above the canopy, the coefficients a, b, and c of the equation [drop = $a + b \cdot t + c \cdot t^2$], where drop is the drop diameter in micrometers and t is the time in seconds from release. Also, the program permits the user to specify a different set of coefficients (a, b and c) for each drop-size category giving the time rate of change of drop size within the forest canopy.

Canopy Penetration Model. The user may run the FSCBG program with or without a forest canopy. A forest canopy may be any vegetation that extends above the ground, where the canopy can be described using up to 3 vegetative height classes. The canopy penetration model calculates the percentage of material in each drop-size category that reaches each tenth of the canopy height. Also, the canopy penetration model determines the horizontal path length of the trajectory of each drop-size category. This information can be optionally printed and is supplied to the dispersion model (if used) for application in the calculation of dosage, concentration and/or deposition.

Dispersion Models. The user has the option of using the dosage, concentration or deposition models or any combination of these models. The program on option will calculate the dosage, concentration and/or deposition at the specified receptor points and at the specified height. At present, dosage and concentration calculations are restricted to heights at or above the canopy height. There are no similar height restrictions on deposition calculations.

3.1.2 Data Input Requirements

This section provides a description of all input data parameters required by the FSCBG program. The user should note that some input parameters are not read or are ignored by the program depending on the values control parameters have been assigned by the user.

Program Control Parameter Input Data. These parameters provide user-control of all program options.

Parameter Name	
TITLE	Titling Information -- This parameter is an array of a maximum of 80 characters specifying the case title. If not input, the program defaults to a blank title.
ISW(1)	Wake-Settling Velocity Option -- This parameter specifies whether the wake-settling velocity is to be input by the user or is to be calculated by the program. If this parameter is set equal to "0" or omitted, the FSCGB program assumes the user desires to input the wake-settling velocity via the parameter WAKVEL below. If this parameter is set equal to "1", the program calculates the wake-settling velocity from the input parameters ARCRWT, WNGSPN, ARCRSP and AIRDEN, defined below.
ISW(2)	Evaporation Model Option -- This parameter specifies whether or not evaporation is to be applied to the drop distribution or whether the user is to input the rate of evaporation of the drops. If this parameter is set equal to "0" or omitted, the program assumes the drops do not evaporate, and passes the drop-size distribution to subsequent program phases unchanged. Also, all equations related to drop size and time assume the drop size is constant with time. If this parameter is set equal to a value of "1", the program calculates the evaporation rate for each drop-size category. The program automatically calculates the drop size as a function of time and the amount of material converted to vapor. The evaporation model is applied to the drop distribution both above and below a forest canopy and the evaporated

Parameter Name	
ISW(2) (Cont.)	drop distributions are passed to subsequent program phases. If this parameter is set equal to "2", the FSCBG program assumes the user desires to input the coefficients a, b and c of the equation giving the drop diameter as a function of time, e.g., $D = a + b \cdot t + c \cdot t^2$. One set of the coefficients a, b and c is required for each drop-size category for both above and below a forest canopy. The variable D in the above equation is the drop diameter in micrometers and t is the time after release.
ISW(3)	Canopy Penetration Model Option -- This parameter controls execution of the canopy penetration model. If this parameter is set equal to "0" or omitted, a forest canopy is not considered in the FSCBG calculations. All input parameters relating to a forest canopy are ignored by the program. If this parameter is set equal to "1", the program assumes there is a forest canopy. The forest canopy may be an actual forest or may be any above-ground vegetation. The canopy penetration model determines the percentage of the drop material from each size category that reaches 10 height levels within the forest canopy, including the ground. If this parameter is set equal to "2", the canopy penetration model calculations are printed as well as calculated.
ISW(4)	Dispersion Models Option -- This parameter controls execution of the dispersion models. If this parameter is set equal to "0" or omitted, the dispersion models (dosage, concentration, deposition) are not executed. All dispersion model related parameters are ignored by the program. If this parameter is set equal to "1", the dispersion models

Parameter Name	
ISW(4) (Cont.)	given by ISW(6), ISW(7) and ISW(8) are executed and the calculations printed.
ISW(5)	Print Evaporation Model (ISW(2)) Calculations Option -- This parameter controls printing of calculations selected under ISW(2). If this parameter is set equal to "0" or omitted, calculations under ISW(2) are not printed. If this parameter is set equal to "1", calculations under ISW(2) are printed.
ISW(6)	Dosage Model Option -- This parameter controls dosage calculations. If this parameter is set equal to "0" or omitted, dosage is not calculated. If this parameter is set equal to "1", dosage at the height specified by Z is calculated and printed. Note that dosage calculations can only be made at heights Z from the top of the forest canopy to the mixing layer height HM.
ISW(7)	Concentration Model Option -- This parameter controls concentration calculations. If this parameter is set equal to "0" or omitted, concentration is not calculated. If this parameter is set equal to "1", concentrations at the height specified by Z are calculated and printed. Note that concentration calculations can only be made at heights Z from the top of the forest canopy to the mixing layer height HM.
ISW(8)	Deposition Model Option -- This parameter controls deposition calculations. If this parameter is set equal to "0" or omitted, deposition is not calculated. If this parameter is set equal to "1", deposition at the height specified by Z is calculated and printed. There are no restrictions

Parameter Name	
ISW(8) (Cont.)	on the calculation height Z for deposition calculations, *e.g.*, deposition can be calculated within the forest canopy.
ISW(9)	Dosage, Concentration and Deposition Output Mass Units -- This option assumes the user has input the release rate Q in units consistent with the definitions of Q and with the parameter SWATH below. All units conversions are handled automatically by the program. The possible output units are:

ISW(9)	Output Units
0 or omitted	drops
1	micrograms
2	milligrams
3	grams
4	ounces
5	pounds

ISW(10)	Dosage Output Time Units Option -- This option assumes the user has input all parameters dependent on time in units of seconds. The possible output units are:

ISW(10)	Output Units
0 or omitted	seconds
1	minutes

ISW(11)	Dosage, Concentration and Deposition Output Volume or Area Length Units Option -- This option assumes the user has input all parameters dependent on length in units of meters. The possible output units are:

Parameter Name					
ISW(11) (Cont.)	ISW(11)	Dosage	Concentration	Deposition	Area-Coverage
	0 or omitted	m^3	m^3	m^2	m^2
	1	ft^3	ft^3	ft^2	ft^2
	2	m^3	m^3	acre	acre
	3	ft^3	ft^3	acre	acre
	4	m^3	m^3	hectare	hectare

ISW(12) Area-Coverage Option -- This option enables the user to calculate the total horizontal area coverage for up to 10 levels of dosage, concentration and/or deposition. If this parameter is set equal to "0" or omitted, area-coverage is calculated for dosage, concentration and/or deposition, depending on ISW(6), ISW(7) and ISW(8), respectively.

ISW(13) - ISW(20 Reserved for Future Options.

Necessary FSCBG Program Input Parameters. These parameters are used by more than one of the FSCBG program models.

Parameter Name

IFWATR Spray Liquid Base -- This parameter is a switch used to inform the FSCBG program when the theoretical calculation for water drop evaporation is to be used. If this parameter is set equal to "1" or omitted, the program assumes the theoretical drop evaporation equations for water are to be used. If this parameter is set equal to "2", the program assumes the spray liquid is not water, but calculates a theoretical evaporation rate requiring these additional input parameters -

Parameter Name	
IFWATR (Cont.)	DFUSIV, HETLAT, CONMOL, THERMC, VAPINF, BCONST and CONST defined below.
WNGSPN	Aircraft Wing Span -- This parameter specifies the aircraft wing span or helicopter rotor diameter in meters (m).
WSOCAN	Wind Speed -- This parameter specifies the wind speed in meters per second ($m\ s^{-1}$) above the canopy.
HGTCFT	Height of Aircraft -- This parameter specifies the height above ground in meters (m) of the spray aircraft.
DENLIQ	Density of the Drop Liquid -- This parameter specifies the density of the spray drop liquid in grams per cubic centimeter ($g\ cm^{-3}$). If this parameter is omitted from the input data, the program defaults to a density of 1.0 gram per cubic centimeter.
AIRTPO	Air Temperature Above the Canopy -- This parameter specifies the air temperature in degrees Celsius (^{o}C) above the canopy.
AIRTPU	Air Temperature Below the Canopy -- This parameter specifies the air temperature in degrees Celsius (^{o}C) below the canopy. If this parameter is omitted from the input data, the program defaults to the value input to AIRTPO.
AIRDEN	Air Density -- This parameter specifies the air density in grams per cubic centimeter ($g\ cm^{-3}$). If this parameter is omitted from the input data, the parameters AIRMOL, AIRPRS and VAPINF defined below, must be input to the FSCBG program.

Wake-Settling Velocity Model Input Data. These parameters are used in calculating the aircraft wake-settling velocity. The parameter ISW(1) specifies which of the parameters described in this section are required by the program.

Parameter Name	
	Parameters Required When (ISW(1) Equals "0" or is Omitted
WAKVEL	Wake Settling Velocity -- This parameter specifies the wake-settling velocity in meters per second (m s^{-1}).
	Parameters Required When ISW(1) Equals "1"
ARCRWT	Aircraft Weight -- This parameter specifies the weight of the aircraft in kilograms (kg) for the calculation of the wake-settling velocity.
ARCRSP	Aircraft Ground Speed -- This parameter specifies the ground speed in meters per second (m s^{-1}) of the spray aircraft for the calculation of the wake-settling velocity.

Evaporation Model Input Data. These data are parameters used in calculations within the Evaporation Model. The parameter ISW(2) specifies which of the parameters in this section are required by the program.

Parameter Name	
	Parameters Required When ISW(2) Equals "0", "1" or is Omitted
DRPUPR	Upper Limits for the Drop-Size Categories -- This parameter is an array specifying the upper limit of each drop-size

Parameter Name	
DRPUPR (Cont.)	category in micrometers (μm) for up to 20 drop-size categories. These values must be input in descending order of diameter and the number of drop-size categories is determined by the program from the number of non-zero input values. If ISW(2) is equal to "0" or omitted, this array may be the mean diameter.
DRPLWR	Lower Limits to the Drop-Size Categories -- This parameter is an array specifying the lower limit of each drop-size category in micrometers (μm) for the same number of drop-size categories input to the array DRPUPR. The lower limit of any drop size category cannot be zero ("0"). If the mean diameter is input to the array DRPUPR, this array is omitted from the input data.
	Parameters Required When ISW(2) Equals "1"
AIRPRS	Air Pressure -- This parameter specifies the barometric pressure in millibars (mb) at the site altitude. If this parameter is omitted from the input data, the program uses 1013.25 millibars as a default value. If the parameter AIRDEN has been omitted, this parameter is required.
AIRMOL	Molecular Weight of Air -- This parameter specifies the molecular weight of air. If this parameter is omitted from the input data, the program uses 28.9644 as a default value. If the parameter AIRDEN has been omitted, this parameter is required.
VAPMOL	Molecular Weight of the Vapor -- This parameter specifies the molecular weight of the vapor from the evaporating

Parameter Name	
VAPMOL (Cont.)	drops. If this parameter is omitted from the input data, the program uses 18.015 as a default value.
RELHMO	Relative Humidity Above the Canopy -- This parameter specifies the relative humidity above the canopy in percent (%). This parameter is required if AIRDEN equals zero or is omitted and VAPINF is omitted from the input data.
RELHMU	Relative Humidity Below the Canopy -- This parameter specifies the relative humidity below the canopy in percent (%). If this parameter is omitted from the input data, the program uses the humidity above the canopy (RELHMO) as a default value. This parameter is required if AIRDEN equals zero or is omitted and VAPINF is omitted and a canopy is being used.

Parameters Required When ISW(2) Equals "1" and IFWATR Equals "2"

DFUSIV — Diffusivity of Evaporating Vapor -- This parameter is required for liquids other than water (IFWATR="2") and specifies the diffusivity of the evaporating vapor into the air at the drop temperature in square centimeters per second ($cm^2\ s^{-1}$). If this parameter is omitted from the input data and IFWATR equals "2", the program calculates DFUSIV, assuming the liquid is similar to water via the equation

$$\mathrm{DFUSIV} = .211 \cdot \left((T_D + 273.16)/273.16\right)^{1.94} \cdot \left(1013.25/\mathrm{AIRPRS}\right) \quad (3\text{-}1)$$

where T_D is the drop temperature approximated by the program.

HETLAT — Latent Heat of Vaporization -- This parameter is required only for liquids other than water (IFWATR="2") and specifies

Parameter Name	
HETLAT (Cont.)	the latent heat of vaporization at the drop temperature in calories per mole (cal $mole^{-1}$). If this parameter is omitted from the input data and IFWATR equals "2", the program calculates HETLAT, assuming the liquid is similar to water, via the equation

$$HETLAT = 597.3 \cdot \left(273.16/(T_D+273.16)\right)^{A} \cdot VAPMOL \qquad (3\text{-}2)$$

where:

$A = 0.107+3.67\text{x}10^{-4} \cdot (T_D+273.16)$

T_D = drop temperature (^{o}C) approximated by the program

CONMOL	Molal Concentration -- This parameter is required only for liquids other than water (IFWATR="2") and specifies the molal concentration of the air-liquid mixture in moles per cubic centimeter (moles cm^{-3}). If this parameter is omitted from the input data and IFWATR equals "2", the program calculates CONMOL, assuming the liquid is similar to water, via the equation

$$CONMOL = AIRDEN/AIRMOL \qquad (3\text{-}3)$$

THERMC	Thermal Conductivity -- This parameter is required only for liquids other than water (IFWATR="2") and specifies the thermal conductivity of the vapor into air at the drop temperature in calories per second centimeter degree Kelvin (cal s^{-1} cm^{-1} $^{o}K^{-1}$). If this parameter is omitted from the input data and IFWATR equals "2", the program calculates THERMC, assuming the liquid is similar to water, via the equation

Parameter
Name

THERMC (Cont.)

$$THERMC = A\left(1-\left(1.17-1.02\left(B/A\right)\right)\right) VAPINF/AIRPRS \qquad (3\text{-}4)$$

where

$$A = 5.69x10^{-5}+1.7x10^{-7}\cdot DRPTMP$$
$$B = 3.78x10^{-5}+2.0x10^{-7}\cdot DRPTMP$$

DRPTMP = calculated drop temperature (^{o}K)

VAPINF = vapor pressure of vapor at infinity (mb)

AIRPRS = barometric pressure (mb)

VAPINF

Vapor Pressure at Infinity -- This parameter is required for liquids other than water (IFWATR="2") and is also required if AIRDEN equals zero or has been omitted from the data deck. This parameter specifies the vapor pressure of the evaporating vapor at infinity in millibars (mb). If VAPINF is input greater than or equal to zero, this value is used. However, if this parameter is omitted from the input data, the program calculates the value of VAPINF from the air temperature (AIRTPO,AIRTPU) and relative humidity (RELHMO,RELHMU).

BCONST & CCONST

Vapor Pressure Equation Constants -- These two parameters are constants used in the equation that describes the vapor pressure as a function of temperature of the non-water (IFWATR="2") liquid via the expression

$$\text{vapor pressure (in Hg)} = \exp\left(BCONST-CCONST/T_D\right) \qquad (3\text{-}5)$$

where T_D is the drop temperature (^{o}C) approximated by the program. The default values for these parameters are 21.07 and 5249.9 for BCONST and CCONST, respectively.

Parameter Name	
	<u>Parameters Required When ISW(2) Equals "2" (User Specifies Time Rate of Evaporation).</u>
DAU, DBU & DCU	Time Rate of Change of Drop Size Above Canopy -- These three arrays specify the coefficients of the equation describing drop size as a function of time above the canopy $$D(\text{micrometers}) = DAU(J)+DBU(J)\cdot T+DCU(J)\cdot T^2 \qquad (3\text{-}6)$$ where D is the diameter of the drop in micrometers (μm), T is the time in seconds after the spray is released and J is the index over the drop-size categories. There are a maximum of 20 values possible for each array. The number of drop-size categories is determined by the program by the number of input values of DAU. The values in each array must be ordered in descending order of drop-size category.
DAL, DBL & DCL	Time Rate of Change of Drop Size Below Canopy -- These three arrays specify the coefficients of the equation describing drop-size as a function of time below the canopy $$D(\text{micrometers}) = DAL(J)+DBL(J)\cdot T+DCL(J)\cdot T^2 \qquad (3\text{-}7)$$ where D is the diameter of the drop in micrometers (μm), T is the time in seconds after the spray is released and J is the index over the drop-size categories. There are a maximum of 20 values possible for each array. The values in each array must be ordered in descending order of drop-size category. If any values for these three arrays are omitted from the input data, the program defaults the repective value from the arrays DAU, DBU and DCU.

Canopy Penetration Model Input Data. These parameters are used in calculations performed by the Canopy Penetration Model and are required by the program only if the parameter ISW(3) is set equal to "1".

Parameter Name	
WSIN44	Wind Speed in Top Quarter of Canopy -- This parameter specifies the wind speed in meters per second ($m\ s^{-1}$) for the top quarter of the canopy. If this parameter is omitted from the input data, the program uses the wind speed above the canopy (WSOCAN) for WSIN44.
WSIN34	Wind speed in the Third Quarter of Canopy -- This parameter specifies the wind speed in meters per second ($m\ s^{-1}$) for the third quarter of the canopy. If this parameter is omitted from the input data, the program uses the value of WSIN44.
WSIN24	Wind Speed in the Second Quarter of Canopy -- This parameter specifies the wind speed in meters per second ($m\ s^{-1}$) for the second quarter of the canopy. If this parameter is omitted from the input data, the program uses the value of WSIN34.
WSIN14	Wind Speed in the Bottom Quarter of Canopy -- This parameter specifies the wind speed in meters per second ($m\ s^{-1}$) for the bottom quarter of the canopy. If this parameter is omitted from the input data, the program uses the value of WSIN24.
HGTCAN	Height of Canopy -- This parameter is an array specifying the height in whole meters (m) of up to three canopy (vegetation) height categories (multi-storied canopy). These values must be input in descending order of height. The

Parameter Name	
HGTCAN (Cont.)	number of canopy height categories is determined by the program from the number of non-zero input values of HGTCAN. There are a maximum of three height categories.
PRBPEN	Probability of Drop Penetration -- This parameter defines an array specifying the probability of drop penetration for a horizontal trajectory through the tree (stem) for up to three canopy height categories. These values are input as fractions in the range of "0" to "1", depending on the density of the vegetation and in the same order as values input to the array HGTCAN.
TREDEN	Tree Density -- This parameter is an array specifying the density of trees per acre (stems $acre^{-1}$) for each canopy height category defined by HGTCAN.
COLEFF	Collection Efficiencies -- This parameter is an array that either specifies the collection efficiencies for each drop-size category or specifies the size of the vegetative elements for each canopy height category, depending on whether the values are negative or positive. If the values input to this array are positive, the program assumes they are the collection efficiencies for each drop-size category. If the values input to the array COLEFF are negative, the program assumes the absolute values are the diameters in centimeters of the vegetative element on which the drop impacts for each canopy-height category. The collection efficiencies are then internally calculated using the following empirical relationship, recommended by Grim and Barry (1975) and attributed to Sell

Parameter Name

COLEFF (Cont.)

$$EFF = \begin{cases} 2.8\text{x}10^{-4} \cdot D_j \cdot u/s & ; \quad EFF \leq 1 \\ 1 & ; \quad EFF > 1 \end{cases} \tag{3-8}$$

where

u = impaction velocity in meters per second (m s^{-1})

D_j = drop diameter for the j^{th} drop-size category in micrometers (μm)

s = diameter in centimeters of the element on which the drop impacts (input as a negative value in COLEFF)

If this array is omitted from the input data, the program will default to a vegetative element size of 13 centimeters by setting the array equal to all values of -13.

TREENV — Tree Envelope -- This parameter is an array specifying the width of the tree height class in meters (m) at each meter of tree height. Values are input in ascending order of the height of the tree class, beginning at one meter. There are exactly HGTCAN(J) values input for each canopy class J. The first HGTCAN(1) values are for height category 1, the second HGTCAN(2) values are for height category 2 and the last HGTCAN(3) values are for height category 3.

Dispersion Model Input Data. These parameters are used in the calculation of dosage, concentration and/or deposition and are required by the program only if ISW(4) is equal to "1".

Parameter Name	
NSOURC	Number of Line Sources -- This parameter specifies the number of line sources or aircraft spray lines to be used. The program is capable of processing a maximum of 100 line sources. If this value is input as "0" or omitted from the input data, the program defaults to a value of "1".
NXPNTS	Number of X (East-West) Receptor Coordinates -- This parameter specifies the number of X (east-west) receptor coordinates in the rectangular receptor grid system. The maximum number of X receptors depends on the values of NYPNTS and NXYPNT and is limited by

$$
\begin{aligned}
&0 < \text{NXPNTS+NYPNTS+2*NXYPNT} \leq 100 \text{ and} \\
&\text{and} \\
&0 < \text{NXPNTS*NYPNTS+NXYPNT} \leq 737
\end{aligned}
\qquad (3\text{-}9)
$$

NYPNTS	Number of Y (North-South) Receptor Coordinates -- This param-parameter specifies the number of Y, (north-south) receptor coordinates in the rectangular receptor grid system. The maximum number of Y receptors is given by Equation (3-9).
NXYPNT	Number of X,Y Discrete (Arbitrarily Placed) Receptor Coordinates -- This parameter specifies the number of X,Y discrete receptor coordinates. The maximum number of discrete coordinates is given by Equation (3-9).
Q	Emission Rate -- This parameter specifies the spray emission rate for the line sources in units of grams per meter, or gallons per acre, depending on the input parameter SWATH. If the parameter SWATH is greater than zero,

Parameter Name	
Q (Cont.)	the program assumes Q is in gallons per acre and the area sprayed is sprayed in lines of an equal distance (SWATH) apart. If the spray lines are not uniform or the area is not regular, input Q in units of grams per meter and set the parameter SWATH equal to "0" or omit SWATH from the input data. If the parameter Q is input as "0" or omitted from the input data, the program defaults to a value of "1". The equation used to convert gallons per acre to grams per meter is given by

$$Q(g/m) = .9352938(\text{acre}\cdot\text{cm}^3/\text{gal}\cdot\text{m}^2)\cdot \text{DENLIQ}(g/\text{cm}^3)\cdot \text{SWATH}(m)\cdot Q(\text{gal/acre})$$

where

DENLIQ = input liquid density
SWATH = input swath width
Q = input emission rate (gal/acre)

SWATH	Distance Between Spray Lines -- This parameter specifies the distance between uniform spray lines in meters. If the input of units of Q are in gallons per acre, then SWATH must be input as a value greater than zero. However, if the input units of Q are grams per meter then SWATH must be input as "0" or omitted from the input data.
Z	Height of Calculations -- This parameter specifies the height above ground in meters at which the calculations of dosage, concentration and deposition are to be performed. The FSCBG program at present does not have the capability to calculate dosage or concentration below the canopy

Parameter Name	
Z (Cont.)	height. However, deposition can be calculated at any height below the mixing depth HM. If this parameter is set to a value of "0" or omitted from the input data, the program assumes ground-level calculations are to be made.
SIGAP	Standard Deviation of the Wind Azimuth Angle -- This parameter specifies the standard deviation of the wind azimuth angle in units of radians or degrees. If the value input is greater than or equal to "1", the program assumes the value is in degrees. If the value input is less than "1", the program assumes the value is in radians.
SIGEP	Standard Deviation of the Wind Elevation Angle -- This parameter specifies the standard deviation of the wind elevation angle in units of radians or degrees. If the value input is greater than or equal to "1", the program assumes the value is in degrees. If the value input is less than "1", the program assumes the value is in radians.
TAU	Time to Cloud Stabilization -- This parameter specifies the time to spray cloud stabilization in seconds. If this parameter is input as "0" or omitted from the input data, the program defaults TAU to 2.5 seconds.
TAUO	Measurement Time for SIGAP -- This parameter specifies the averaging time for the standard deviation of the wind azimuth angle in seconds. If this parameter is input as "0" or omitted from the input data, the program defaults TAUO to 600 seconds.

Parameter Name	
SIGXYZ	Standard Deviation of the Spray Material Distribution -- This parameter specifies the standard deviation of the spray material distribution along the spray line in units of meters. If this parameter is input as "0" or omitted from the input data, the program defaults SIGXYZ to WNGSPN/4.3.
XLRZ	Lateral/Vertical Reference Distance -- This parameter specifies the lateral and vertical reference distance in meters downwind from the spray line where the spray cloud has dimensions given by SIGXYZ. This parameter is normally calculated by the FSCBG program. However, if XLRZ is input greater than or equal to zero, the input value is used.
DELU	Wind Speed-Shear -- This parameter specifies the wind speed shear between the canopy and the aircraft height in meters per second. The default for this parameter is "0".
HM	Surface Mixing Layer Height -- This parameter specifies the height of the surface mixing layer in meters.
THETA	Wind Direction -- This parameter specifies the wind direction (direction from which wind is blowing) in degrees, measured clockwise from 0 degrees (north).
DAREA	Area Assignment for Discrete Receptors -- This parameter specifies the area assignment in square meters to be used in the calculation of area-coverage for discrete receptors. If this parameter is set equal to "0" or omitted from

Parameter Name	
DAREA (Cont.)	the input data, the program defaults DAREA to 10000 square meters (1 hectare).
BETA1	Ratio of Lagrangian to Eulerian Time-Scales - This parameter specifies the ratio of Lagrangian to Eulerian time-scales to be used in the calculation of the correction factor for SIGEP and SIGAP for crossing-trajectory effects of heavy drops when evaporation is not occurring. If this parameter is set equal to "0" or omitted from the input data, no correction factor is applied. Normally a value of "1" is input for the application of this correction factor. The equations used in the correction factor are given by

$$\text{SIGEPR} = \begin{cases} \text{SIGEP}/\left[1+\left(\text{BETA1}\cdot V_s/(\text{WSOCAN}\cdot\text{SIGEP})\right)^2\right]^{.25} & ;\ \text{if BETA1} > 0\ \&\ V_s/(\text{SIGEP}\cdot\text{WSOCAN}) > .2386\ \text{(non-evaporation only)} \\ \text{SIGEP} & ;\ \text{if BETA1} = 0\ \text{or}\ V_s/(\text{SIGEP}\cdot\text{WSOCAN}) \le .2386 \end{cases} \tag{3-11}$$

Parameter Name

$$\text{SIGAPR} = \begin{cases} \text{SIGAP}/\left[1+4\cdot\left(\text{BETA1}\cdot V_s/(\text{WSOCAN}\cdot\text{SIGEP})\right)^2\right]^{.25} & ;\ \text{if BETA1} > 0\ \&\ (\text{SIGEP}\cdot\text{WSOCAN}) > .2386\ \text{(non-evaporation only)} \\ \text{SIGAP} & ;\ \text{of BETA1} = 0\ \text{or}\ \text{VS}/(\text{SIGEP}\cdot\text{WSOCAN}) \leq .2386 \end{cases} \quad (3\text{-}12)$$

X

Receptor X (East-West) Coordinates -- This parameter is an array specifying the values of the X axis of the rectangular grid system and discrete receptor coordinates in meters. The first NXPNTS values input to this array comprise the X axis of the grid system and are input in ascending (negative to positive) order of value. These values are immediately followed by NXYPNT values giving the X coordinates of the discrete (arbitrarily placed) receptors. The negative X axis is west (270 degrees) and the positive X axis is east (90 degrees).

Y

Receptor Y (North-South) Coordinates -- This parameter is an array specifying the values of the Y axis of the rectangular grid system and discrete receptor coordinates in meters. The first NYPNTS values input to this array comprise the Y axis of the grid system and are input in ascending (negative to positive) order of value. These values are immediately followed by NXYPNT values giving the Y coordinates

Parameter Name	
GAMA, GAMB & GAMC (Cont.)	$$j = \begin{cases} 1 \ ; & \text{if } V_s \geq \text{VSGAM(1)} \\ 2 \ ; & \text{if } V_s \geq \text{VSGAM(2)} \ \& \ V_s < \text{VSGAM(1)} \\ 3 \ ; & \text{if } V_s < \text{VSGAM(2)} \end{cases}$$ Three coefficients of GAMA, GAMB and GAMC each are required. The first value of each array is for settling velocities greater than or equal to the paramter VSGAM(1). The second value of each array is for settling velocities less than VSGAM(1) and greater than or equal to VSGAM(2). The third value of each array is for settling velocities less than VSGAM(2). Default values for these arrays are provided only if the parameter is omitted from the input data. The default values are GAMA(1) = 0.75 , GAMB(1) = - 2.5 , GAMC(1) = 0.0 GAMA(2) = 0.83465302, GAMB(2) = - 6.9031391, GAMC(2) = 57.409256 GAMA(3) = 0.91639996, GAMB(3) = -22.357124 , GAMC(3) = 821.42651
VSGAM	Settling Velocities for Fraction of Surface Reflection -- This array specifies two drop settling velocites in meters per second that break the curve of the fraction of material reflected at the surface given by GAMA, GAMB and GAMC into three parts. V_s values greater than or equal to VSGAM(1) use GAMA(1), GAMB(1) and GAMC(1) to calculate the fraction of material reflected at the surface. V_s values less than VSGAM(1) but greater than or equal to VSGAM(2) use GAMA(2), GAMB(2) and GAMC(2) to calculate the fraction of material reflected at the surface. V_s values less than VSGAM(2) use GAMA(3), GAMB(3) and GAMC(3). Default values for VSGAM are provided only if VSGAM is omitted from the input data. The default values are VSGAM(1) = 0.04 , VSGAM(2) = 0.012

Parameter Name	
Y (Cont.)	of the discrete (arbitrarily placed) receptors. The negative Y axis is south (180 degrees) and the positive Y axis is north (0 degrees).
DX	Source X (East-West) Coordinates -- This parameter is an array specifying the start and end X coordinate of each line source in meters. Input the start followed by the end X coordinate for each source. Either end of the line may be the start coordinate.
DY	Source Y (North-South) Coordinates -- This parameter is an array specifying the start and end Y coordinate of each line source in meters. Input the start followed by the end Y coordinate for each source.
PCTMAT	Fraction of Total Material -- This parameter is an array specifying the fraction of the total spray material in each drop-size category. Input these values in descending order of drop-size categories.
GAMA, GAMB & GAMC	Coefficients of the Equation of the Fraction of Surface Reflection -- These three arrays specify the coefficients of the equation giving the fraction of material reflected at the surface as a function of the drop settling velocity

$$R = GAMA_j + GAMB_j \cdot V_s + GAMC_j \cdot V_s^2 \tag{3-13}$$

where

V_s = drop settling velocity in meters per second

Parameter Name	
DOSLV	Dosage Area-Coverage -- This parameter is an array specifying the dosage levels in output dosage units for which dosage area-coverage is to be calculated. This array is not used by the program if either ISW(6) or ISW(12) are equal to "0". There are a maximum of 10 values possible.
CONLV	Concentration Area-Coverage -- This parameter is an array specifying the concentration levels in output concentration units for which concentration area-coverage is to be calculated. This array is not used by the program if either ISW(7) or ISW(12) are equal to "0". There are a maximum of 10 values possible.
DEPLV	Deposition Area-Coverage -- This parameter is an array specifying the deposition levels in output deposition units for which deposition area-coverage is to be calculated. This array is not used by the program if either ISW(8) or ISW(12) are equal to "0". There are a maximum of 10 values possible.

3.1.3 Output Information

The FSCBG program generates four categories of print output. Each category, except the first, is optional to the user. In the following paragraphs, each category of output is related to the specific input parameter or parameters that control the output category. All program output is printed.

Input Parameter Output. The first page of output produced by the FSCBG program is a listing of all input data read by the program. An example listing of this table is shown in Figure 3-1. Note that input parameters that have been omitted and are to be calculated by the program are shown as * symbols. A similar listing on a different computer might show $ symbols

```
FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                    *** DATE 11/24/80, PAGE   1
                                                 TABLE  1
                                          - PROGRAM INPUT DATA -
                                  (NOTE - ******* MEANS NOT APPLICABLE)

     *** INPUTS USED BY ALL MODELS ***
PROGRAM OPTIONS, (ISW) = 1 1 2 1 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0
IS LIQUID WATER OR NON-WATER, 2=NON-WATER, 1=WATER, (IFWATR) = 1
AIRCRAFT WING SPAN (WNGSPN (METERS)) =  11.48
WIND SPEED ABOVE CANOPY (WSOCAN (M/S)) = 1.020
HEIGHT OF AIRCRAFT (HGTCFT (METERS)) =  18.10
DENSITY OF SPRAY LIQUID (DENLIQ (G/CM**3)) =    1.0000
AIR TEMPERATURE ABOVE THE CANOPY (AIRTPO (DEG C)) = 14.400
AIR TEMPERATURE BELOW THE CANOPY (AIRTPU (DEG C)) = 14.400
AIR DENSITY (AIRDEN (G/CM**3)) =*********
MOLECULAR WEIGHT OF AIR (AIRMOL) = 28.9644
BAROMETRIC PRESSURE (AIRPRS (MB)) =1013.25
VAPOR PRESS OF EVAPORATING VAPOR AT INFINITY (VAPINF (MB)) =********
RELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) = 98.900
RELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) = 98.900
     *** INPUTS USED BY THE WAKE SETTLING VELOCITY MODEL ***
AIRCRAFT WEIGHT (ARCRWT (KG)) = 1406.000
AIRCRAFT GROUND SPEED (ARCRSP (M/S)) =  40.200
     *** INPUTS USED BY THE EVAPORATION MODEL ***
UPPER LIMITS OF DROP DIAMETERS (DRPUPR (MICRO-M)) =
1420.000,1020.000, 840.000, 742.000, 667.000, 577.000, 514.000,
 456.000, 351.000, 302.000, 253.000, 200.000, 169.000, 135.000,
 100.000,  51.600,
LOWER LIMITS OF DROP DIAMETERS (DRPLWR (MICRO-M)) =
1020.000, 840.000, 742.000, 667.000, 577.000, 514.000, 456.000,
 351.000, 302.000, 253.000, 200.000, 169.000, 135.000, 100.000,
  51.600,  20.000,
BAROMETRIC PRESSURE (AIRPRS (MB)) =1013.25
MOLECULAR WEIGHT OF AIR (AIRMOL) = 28.9644
MOLECULAR WEIGHT OF EVAPORATING VAPOR (VAPMOL) = 18.0150
RELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) = 98.900
RELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) = 98.900
```

FIGURE 3-1. FSCBG Program Input Data Listing

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FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                        *** DATE 11/24/80, PAGE   2
                                                    TABLE  1 (CONT.)
                                                 - PROGRAM INPUT DATA -
                                          (NOTE - ******* MEANS NOT APPLICABLE)

      *** INPUTS USED BY THE CANOPY PENETRATION MODEL ***
   WIND SPEED IN BOTTOM QUARTER OF CANOPY (WSIN14 (M/S)) =  .950
   WIND SPEED IN SECOND QUARTER OF CANOPY (WSIN24 (M/S)) =  .840
   WIND SPEED IN THIRD QUARTER OF CANOPY (WSIN34 (M/S)) =  .820
   WIND SPEED IN TOP QUARTER OF CANOPY (WSIN44 (M/S)) =  .900
   HEIGHT OF CANOPY (HGTCAN (METERS)) = 12.00,    .00,    .00,
   PROBABILITY OF PENETRATION (PRBPEN) = .380, .000, .000,
   TREE DENSITY (TREDEN (TREES/ACRE)) =  96.80,     .00,     .00,
   DIAMETER OF VEGETATIVE ELEMENTS (COLEFF (CM)) = 13.00, 13.00, 13.00,
   TREE WIDTH FROM BOTTOM TO TOP FOR FOREST CLASS 1 (TREENV (M)) =
     .210,  .190,  .190, 3.800, 6.600, 6.200, 5.800, 6.400, 5.000,
    4.000, 3.300, 1.600,
```

FIGURE 3-1. (Continued)

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FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                    *** DATE 11/24/80, PAGE   3
                                              TABLE  1 (CONT.)
                                           - PROGRAM INPUT DATA -
                                   (NOTE - ******* MEANS NOT APPLICABLE)

     *** INPUTS USED BY THE DISPERSION MODELS ***
NUMBER OF LINE SOURCES (NSOURC) =   7
NUMBER OF RECEPTORS IN GRID SYSTEM X AXIS (NXPNTS) =  51
NUMBER OF RECEPTORS IN GRID SYSTEM Y AXIS (NYPNTS) =   1
NUMBER OF DISCRETE RECEPTORS (NXYPNT) =   0
EMISSION OF SPRAY MATERIAL (Q (GRAMS/M)) = .573300+002
HEIGHT OF DISPERSION MODELS CALCULATION (Z (M)) =     .00
STANDARD DEV. OF WIND DIRECTION ANGLE (SIGAP (RAD)) = .24609
STANDARD DEV. OF WIND ELEVATION ANGLE (SIGEP (RAD)) = .20420
TIME TO SPRAY CLOUD STABILIZATION (TAU (SEC)) =   2.500
MEASUREMENT TIME FOR SIGAP (TAUD (SEC)) = 600.000
STAND. DEV. OF SPRAY MATERIAL ALONG SPRAY LINE (SIGXYZ (M)))=   4.000
DECAY COEFFICIENT (DECAY (/SEC)) = .000000
LAT., VERT. REFERENCE DISTANCE (XLRZ (M)) =**********
SURFACE MIXING LAYER HEIGHT (HM (M)) = 1000.000
WIND DIRECTION (FROM) (THETA (DEG)) =  23.00
AREA ASSIGNMENT FOR DISCRETE RECEPTORS (DAREA (M**2)) =    10000.00
RATIO OF LAGRANGIAN TO EULERIAN TIME SCALES (BETA1) =  .00
WIND-SPEED SHEAR (DELU (M/S)) =  .0000
X AXIS OF RECEPTOR GRID SYSTEM (X (M)) =     -82.3,    -81.4,
    -80.5,    -79.6,    -78.6,    -77.7,    -76.8,    -75.9,
    -75.0,    -74.1,    -73.2,    -72.2,    -71.3,    -70.4,
    -69.5,    -68.6,    -67.7,    -66.8,    -65.8,    -64.9,
    -64.0,    -63.1,    -62.2,    -61.3,    -60.4,    -59.4,
    -58.5,    -57.6,    -56.7,    -55.8,    -54.9,    -53.9,
    -53.0,    -52.1,    -51.2,    -50.3,    -49.4,    -48.5,
    -47.5,    -46.6,    -45.7,    -44.8,    -43.9,    -43.0,
    -42.1,    -41.1,    -40.2,    -39.3,    -38.4,    -37.5,
    -36.6,
Y AXIS OF RECEPTOR GRID SYSTEM (Y (M)) =     153.2,
START AND END X COORDINATES OF LINE SOURCES (DX (M)) =
    -86.9,    -86.9,    -77.7,    -77.7,    -68.6,    -68.6,
    -59.4,    -59.4,    -50.3,    -50.3,    -41.1,    -41.1,
    -32.0,    -32.0,
START AND END Y COORDINATES OF LINE SOURCES (DY (M)) =
    370.3,   -384.3,    370.3,   -384.3,    370.3,   -384.3,
    370.3,   -384.3,    370.3,   -384.3,    370.3,   -384.3,
    370.3,   -384.3,
FRACTION OF SPRAY MATERIAL FOR EACH DROP CAT. (PCTMAT) = .01000,
 .02000, .03000, .04000, .10000, .10000, .10000, .20000, .10000,
 .10000, .10000, .04000, .03000, .02000, .00900, .00100,
SETTLING VEL. SPECIFYING WHICH SET OF GAMA, GAMB AND GAMC TO
USE (VSGAM (M S)) =  .0400,  .0120
COEFFICIENTS OF EQUATIONS GIVING SURF. REFLECT. COEFFS. (GAMA,GAMB,GAMC) =
 .750000+000, .834653+000, .916400+000,-.250000+001,-.690314+001,
-.223571+002, .000000    , .574093+002, .821427+003,
```

FIGURE 3-1.   (Continued)

rather than * symbols. Figure 3-1 consists of three pages of program output. The first page shows the parameters used by all program models, those used by the wake-settling velocity model and those used by the evaporation model. The second page of this table shows the parameters used by the canopy penetration model and the third page shows those used by the dispersion models.

Evaporation Model Output. This output is controlled by the parameter ISW(5). The user has the option of not printing (ISW(5)="0" or printing the results of these calculations (ISW(5)="1"). An example output listing produced by ISW(5) equal to "1" is shown in Figure 3-2. The first page of Figure 3-2 shows calculated parameters used by the evaporation model that are primarily of theoretical interest. The second page shows a detail of the above canopy evaporation for drop size category 1. The listing gives the height of the drop, the maximum, mean and minimum size, the total mass loss due to evaporation, the mass loss in the height interval due to evaporation, the travel time, the horizontal distance, the settling velocity and the percent of the material reaching the indicated height as drops. Following the evaporation detail for drop-size category 1, the program prints the coefficients for the equations of settling velocity as a function of distance, height as a function of distance, fraction of drops as a function of height, time as a function of height and drop size as a function of time. The evaporation detail and following equation coefficients are repeated for each drop-size category, largest to smallest. The program then prints the same information for each drop-size category below the canopy. The last three pages of Figure 3-2 show the evaporation detail below the canopy for drop size category 1. If the drop-size category evaporates prior to reaching the canopy the program will print a "DROP EVAPORATED" message for the below canopy evaporation detail.

Canopy Penetration Model Output. This output is controlled by the parameter ISW(3). The user can elect either not to print (ISW(3)="0") or to print ISW(3)="1") the results of these calculations. An example output listing produced by ISW(3) equal to "1" is shown in Figure 3-3. The canopy

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FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                    *** DATE 11/24/80, PAGE   4

                                                    TABLE  2
                                  - ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

         VAPOR PRESSURE OF LIQUID AT INFINITY = .16276310+002 (MB)
         AIR DENSITY = .12200585-002 (G/CM**3)
         MOLAL CONCENTRATION OF AIR-LIQUID MIXTURE = .42122692-004 (G/CM**3)
         DIFFUSIVITY OF EVAPORATING VAPOR INTO AIR AT THE DROP TEMPERATURE = .23294216+000 (CM**2/SEC)
         THERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT THE DROP TEMPERATURE = .53880651-004 (CAL/(SEC.CM.DEGREE K))
         LATENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE = .59086238+003 (CAL/MOLE)
         DROP PRESSURE = .16340134+002 (MB)
         DROP TEMPERATURE = .14290404+002 (DEGREES C)
         WAKE SETTLING VELOCITY = .54999816+000 (M/S)
         ABSOLUTE VISCOSITY (GM/CM/SEC) = .12499794-003
         SCHMIDT NUMBER = .43981910+000
```

FIGURE 3-2. Evaporation Model Calculations Listing

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
18.100	1420.000	1230.992	1020.000	.0000	.0000	.000	.00	4.9376646	100.000
17.798	1419.999	1230.990	1019.998	.3444-008	.3444-008	.061	.06	4.9376601	100.000
17.497	1419.997	1230.989	1019.997	.6850-008	.3406-008	.122	.12	4.9376557	99.999
17.195	1419.996	1230.988	1019.995	.1029-007	.3436-008	.183	.19	4.9376512	99.999
16.893	1419.994	1230.986	1019.994	.1370-007	.3413-008	.244	.25	4.9376467	99.999
16.592	1419.993	1230.985	1019.992	.1714-007	.3436-008	.305	.31	4.9376423	99.998
16.290	1419.992	1230.983	1019.991	.2053-007	.3391-008	.367	.37	4.9376379	99.998
15.988	1419.990	1230.982	1019.989	.2396-007	.3436-008	.428	.44	4.9376335	99.998
15.687	1419.989	1230.980	1019.988	.2741-007	.3444-008	.489	.50	4.9376289	99.997
15.385	1419.987	1230.979	1019.986	.3081-007	.3406-008	.550	.56	4.9376246	99.997
15.083	1419.986	1230.977	1019.985	.3425-007	.3436-008	.611	.62	4.9376200	99.996
14.782	1419.985	1230.976	1019.983	.3767-007	.3421-008	.672	.69	4.9376156	99.996
14.480	1419.983	1230.975	1019.982	.4108-007	.3406-008	.733	.75	4.9376112	99.996
14.178	1419.982	1230.973	1019.980	.4451-007	.3436-008	.794	.81	4.9376068	99.995
13.877	1419.980	1230.972	1019.979	.4793-007	.3413-008	.855	.87	4.9376023	99.995
13.575	1419.979	1230.970	1019.977	.5135-007	.3421-008	.916	.93	4.9375979	99.995
13.273	1419.978	1230.969	1019.976	.5478-007	.3429-008	.978	1.00	4.9375935	99.994
12.972	1419.976	1230.967	1019.974	.5821-007	.3436-008	1.039	1.06	4.9375890	99.994
12.670	1419.975	1230.966	1019.973	.6163-007	.3421-008	1.100	1.12	4.9375845	99.994
12.368	1419.973	1230.965	1019.971	.6506-007	.3429-008	1.161	1.18	4.9375801	99.993
12.067	1419.972	1230.963	1019.970	.6848-007	.3413-008	1.222	1.25	4.9375756	99.993
11.765	1419.971	1230.962	1019.968	.7192-007	.3444-008	1.283	1.31	4.9375711	99.993
11.463	1419.969	1230.960	1019.967	.7533-007	.3406-008	1.344	1.37	4.9375668	99.992
11.162	1419.968	1230.959	1019.965	.7874-007	.3413-008	1.405	1.43	4.9375623	99.992
10.860	1419.966	1230.957	1019.964	.8215-007	.3413-008	1.466	1.50	4.9375578	99.992
10.558	1419.965	1230.956	1019.962	.8560-007	.3444-008	1.527	1.56	4.9375534	99.991
10.257	1419.964	1230.954	1019.961	.8900-007	.3406-008	1.588	1.62	4.9375490	99.991
9.955	1419.962	1230.953	1019.959	.9244-007	.3436-008	1.650	1.68	4.9375445	99.991
9.653	1419.961	1230.952	1019.957	.9588-007	.3444-008	1.711	1.74	4.9375400	99.990
9.352	1419.959	1230.950	1019.956	.9929-007	.3406-008	1.772	1.81	4.9375356	99.990
9.050	1419.958	1230.949	1019.954	.1027-006	.3413-008	1.833	1.87	4.9375312	99.989
8.748	1419.957	1230.947	1019.953	.1061-006	.3436-008	1.894	1.93	4.9375267	99.989
8.447	1419.955	1230.946	1019.951	.1096-006	.3413-008	1.955	1.99	4.9375222	99.989
8.145	1419.954	1230.944	1019.950	.1130-006	.3436-008	2.016	2.06	4.9375178	99.988
7.843	1419.952	1230.943	1019.948	.1164-006	.3413-008	2.077	2.12	4.9375134	99.988
7.542	1419.951	1230.941	1019.947	.1198-006	.3436-008	2.138	2.18	4.9375089	99.988
7.240	1419.950	1230.940	1019.945	.1233-006	.3413-008	2.199	2.24	4.9375045	99.987
6.938	1419.948	1230.939	1019.944	.1267-006	.3413-008	2.261	2.31	4.9375000	99.987
6.637	1419.947	1230.937	1019.942	.1301-006	.3421-008	2.322	2.37	4.9374956	99.987
6.335	1419.945	1230.936	1019.941	.1335-006	.3452-008	2.383	2.43	4.9374911	99.986
6.033	1419.944	1230.934	1019.939	.1369-006	.3391-008	2.444	2.49	4.9374867	99.986
5.732	1419.943	1230.933	1019.938	.1404-006	.3436-008	2.505	2.56	4.9374823	99.986
5.430	1419.941	1230.931	1019.936	.1438-006	.3413-008	2.566	2.62	4.9374778	99.985

FIGURE 3-2. (Continued)

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	DROP DIAMETER AVERAGE (MICRO-M)	DROP DIAMETER MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	MASS LOST DUE TO EVAPORATION IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
5.128	1419.940	1230.930	1019.935	.1472-006	.3436-008	2.627	2.68	4.9374734	99.985
4.827	1419.939	1230.929	1019.933	.1506-006	.3413-008	2.688	2.74	4.9374689	99.985
4.525	1419.937	1230.927	1019.932	.1541-006	.3436-008	2.749	2.80	4.9374645	99.984
4.223	1419.936	1230.926	1019.930	.1575-006	.3413-008	2.810	2.87	4.9374600	99.984
3.922	1419.934	1230.924	1019.929	.1609-006	.3436-008	2.872	2.93	4.9374556	99.984
3.620	1419.933	1230.923	1019.927	.1643-006	.3406-008	2.933	2.99	4.9374511	99.983
3.318	1419.932	1230.921	1019.926	.1678-006	.3444-008	2.994	3.05	4.9374467	99.983
3.017	1419.930	1230.920	1019.924	.1712-006	.3413-008	3.055	3.12	4.9374422	99.982
2.715	1419.929	1230.919	1019.923	.1746-006	.3406-008	3.116	3.18	4.9374378	99.982
2.413	1419.927	1230.917	1019.921	.1780-006	.3444-008	3.177	3.24	4.9374334	99.982
2.112	1419.926	1230.916	1019.920	.1814-006	.3413-008	3.238	3.30	4.9374289	99.981
1.810	1419.925	1230.914	1019.918	.1849-006	.3429-008	3.299	3.37	4.9374244	99.981
1.508	1419.923	1230.913	1019.917	.1883-006	.3436-008	3.360	3.43	4.9374200	99.981
1.207	1419.922	1230.911	1019.915	.1917-006	.3421-008	3.421	3.49	4.9374155	99.980
.905	1419.920	1230.910	1019.913	.1952-006	.3429-008	3.482	3.55	4.9374111	99.980
.603	1419.919	1230.908	1019.912	.1986-006	.3413-008	3.544	3.61	4.9374066	99.980
.302	1419.918	1230.907	1019.910	.2020-006	.3421-008	3.605	3.68	4.9374022	99.979
.000	1419.916	1230.906	1019.909	.2054-006	.3406-008	3.666	3.74	4.9373978	99.979
-.302	1419.915	1230.904	1019.907	.2088-006	.3436-008	3.727	3.80	4.9373933	99.979
-1.098	1419.911	1230.900	1019.903	.2179-006	.1253-007	3.888	3.97	4.9373815	99.978
-2.245	1419.906	1230.895	1019.898	.2310-006	.1804-007	4.120	4.20	4.9373645	99.976
-3.896	1419.898	1230.887	1019.889	.2498-006	.2596-007	4.455	4.54	4.9373401	99.974
-6.274	1419.887	1230.875	1019.877	.2770-006	.3743-007	4.937	5.04	4.9373048	99.972
-9.699	1419.871	1230.859	1019.860	.3161-006	.5390-007	5.630	5.74	4.9372541	99.968
-14.630	1419.848	1230.835	1019.835	.3724-006	.7762-007	6.629	6.76	4.9371809	99.962
-21.730	1419.814	1230.801	1019.799	.4535-006	.1118-006	8.067	8.23	4.9370755	99.954
-31.956	1419.767	1230.752	1019.748	.5703-006	.1611-006	10.138	10.34	4.9369237	99.942
-46.680	1419.698	1230.681	1019.674	.7385-006	.2320-006	13.121	13.38	4.9367052	99.924
-67.882	1419.598	1230.580	1019.567	.9808-006	.3340-006	17.416	17.76	4.9363903	99.900
-98.414	1419.455	1230.433	1019.413	.1330-005	.4809-006	23.601	24.07	4.9359370	99.864
-142.380	1419.249	1230.222	1019.191	.1832-005	.6924-006	32.509	33.16	4.9352840	99.812
-205.691	1418.952	1229.918	1018.871	.2555-005	.9970-006	45.337	46.24	4.9343435	99.738
-296.859	1418.525	1229.479	1018.411	.3596-005	.1435-005	63.815	65.09	4.9329887	99.632
-428.141	1417.909	1228.848	1017.748	.5094-005	.2066-005	90.430	92.24	4.9310368	99.478
-617.187	1417.022	1227.939	1016.793	.7249-005	.2973-005	128.774	131.35	4.9282241	99.258
-889.412	1415.743	1226.628	1015.416	.1035-004	.4277-005	184.023	187.70	4.9241696	98.940
-1281.418	1413.900	1224.738	1013.431	.1481-004	.6150-005	263.655	268.93	4.9183226	98.484
-1845.905	1411.242	1222.013	1010.567	.2122-004	.8839-005	378.476	386.05	4.9098852	97.828
-2880.045	1406.358	1217.006	1005.306	.3291-004	.1170-004	589.267	601.05	4.8943759	96.630
-3905.953	1401.495	1212.019	1000.063	.4447-004	.1155-004	799.042	815.02	4.8789136	95.447
-5429.520	1394.238	1204.576	992.234	.6154-004	.1707-004	1111.811	1134.05	4.8558078	93.700
-6934.923	1387.026	1197.177	984.447	.7830-004	.1676-004	1422.322	1450.77	4.8328068	91.984
-8914.237	1377.478	1187.382	974.130	.1002-003	.2187-004	1832.851	1869.51	4.8023037	89.744

FIGURE 3-2. (Continued)

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
-10378.080	1370.368	1180.087	966.443	.1162-003	.1606-004	2138.154	2180.92	4.7795514	98.100

FIGURE 3-2. (Continued)

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FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                    *** DATE 11/24/80, PAGE   8

                                      TABLE  2 (CONT.)
                         - ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

          - CALCULATED EQUATIONS FOR DROP SIZE CATEGORY  1 (1020.000 - 1420.000 MICRO-M) -

                          SETTLING VELOCITY AS A FUNCTION OF DISTANCE
          VS(MPS) =  .49376656+001 + -.71841217-004 *X+ -.30143473-009 *X**2

                                HEIGHT AS A FUNCTION OF DISTANCE
           H(M) =  .18119107+002 + -.48426686+001 *X+  .34569162-004 *X**2

           FRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HEIGHT
           FRACT =  .99978900+000 +  .11697134-004 *H+  .24207153-010 *H**2

                                  TIME AS A FUNCTION OF HEIGHT
         TIME(SEC) =  .36692189+001 + -.20243053+000 *H+  .30951647-006 *H**2

                              DROP DIAMETER AS A FUNCTION OF TIME
      DROP(MICRO-M) =  .12309922+004 + -.23706743-001 *T+ -.47505991-007 *T**2
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FIGURE 3-2. (Continued)

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FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                                   *** DATE 11/24/80, PAGE  64

                                                        TABLE  3
                                     - BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

         VAPOR PRESSURE OF LIQUID AT INFINITY = .16276310+002 (MB)
         AIR DENSITY = .12200585-002 (G/CM**3)
         MOLAL CONCENTRATION OF AIR-LIQUID MIXTURE = .42122692-004 (G/CM**3)
         DIFFUSIVITY OF EVAPORATING VAPOR INTO AIR AT THE DROP TEMPERATURE = .23294216+000 (CM**2/SEC)
         THERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT THE DROP TEMPERATURE = .59880651-004 (CAL/(SEC.CM.DEGREE K))
         LATENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE = .59086238+003 (CAL/MOLE)
         DROP PRESSURE = .16340134+002 (MB)
         DROP TEMPERATURE = .14290404+002 (DEGREES C)
         WAKE SETTLING VELOCITY = .54999816+000 (M/S)
         ABSOLUTE VISCOSITY (GM/CM/SEC) = .12499794-003
         SCHMIDT NUMBER = .43981910+000
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FIGURE 3-2. (Continued)

TABLE 3 (CONT.)
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1019.970 - 1419.972 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	DROP DIAMETER AVERAGE (MICRO-M)	DROP DIAMETER MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	MASS LOST DUE TO EVAPORATION IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
12.000	1419.972	1230.963	1019.970	.6848-007	.0000	1.222	1.25	4.9375756	99.993
11.800	1419.971	1230.962	1019.969	.7076-007	.2286-008	1.262	1.28	4.9375727	99.993
11.600	1419.970	1230.961	1019.968	.7305-007	.2286-008	1.303	1.32	4.9375696	99.993
11.400	1419.969	1230.960	1019.967	.7533-007	.2278-008	1.343	1.36	4.9375667	99.992
11.200	1419.968	1230.959	1019.966	.7761-007	.2286-008	1.384	1.39	4.9375637	99.992
11.000	1419.967	1230.958	1019.965	.7987-007	.2263-008	1.424	1.43	4.9375607	99.992
10.800	1419.966	1230.957	1019.964	.8215-007	.2278-008	1.465	1.47	4.9375578	99.992
10.600	1419.965	1230.956	1019.963	.8441-007	.2263-008	1.505	1.50	4.9375549	99.991
10.400	1419.965	1230.955	1019.962	.8669-007	.2278-008	1.546	1.54	4.9375520	99.991
10.200	1419.964	1230.954	1019.961	.8898-007	.2286-008	1.586	1.57	4.9375490	99.991
10.000	1419.963	1230.954	1019.960	.9124-007	.2263-008	1.627	1.61	4.9375460	99.991
9.800	1419.962	1230.953	1019.959	.9353-007	.2286-008	1.667	1.65	4.9375430	99.990
9.600	1419.961	1230.952	1019.958	.9579-007	.2263-008	1.708	1.68	4.9375402	99.990
9.400	1419.960	1230.951	1019.957	.9808-007	.2286-008	1.748	1.72	4.9375371	99.990
9.200	1419.959	1230.950	1019.956	.1003-006	.2271-008	1.789	1.76	4.9375342	99.990
9.000	1419.958	1230.949	1019.955	.1026-006	.2263-008	1.829	1.79	4.9375312	99.989
8.800	1419.957	1230.948	1019.954	.1049-006	.2286-008	1.870	1.83	4.9375283	99.989
8.600	1419.956	1230.947	1019.953	.1072-006	.2286-008	1.911	1.86	4.9375253	99.989
8.400	1419.955	1230.946	1019.952	.1094-006	.2263-008	1.951	1.89	4.9375224	99.989
8.200	1419.954	1230.945	1019.951	.1117-006	.2278-008	1.992	1.93	4.9375194	99.989
8.000	1419.953	1230.944	1019.950	.1140-006	.2286-008	2.032	1.96	4.9375165	99.988
7.800	1419.952	1230.943	1019.949	.1163-006	.2278-008	2.073	1.99	4.9375135	99.988
7.600	1419.952	1230.942	1019.947	.1185-006	.2263-008	2.113	2.03	4.9375106	99.988
7.400	1419.951	1230.941	1019.946	.1208-006	.2263-008	2.154	2.06	4.9375076	99.988
7.200	1419.950	1230.940	1019.945	.1231-006	.2286-008	2.194	2.09	4.9375046	99.987
7.000	1419.949	1230.939	1019.944	.1254-006	.2278-008	2.235	2.13	4.9375017	99.987
6.800	1419.948	1230.938	1019.943	.1276-006	.2263-008	2.275	2.16	4.9374987	99.987
6.600	1419.947	1230.937	1019.942	.1299-006	.2286-008	2.316	2.19	4.9374958	99.987
6.400	1419.946	1230.936	1019.941	.1322-006	.2286-008	2.356	2.22	4.9374928	99.986
6.200	1419.945	1230.935	1019.940	.1345-006	.2278-008	2.397	2.26	4.9374899	99.986
6.000	1419.944	1230.934	1019.939	.1367-006	.2255-008	2.437	2.29	4.9374869	99.986
5.800	1419.943	1230.933	1019.938	.1390-006	.2286-008	2.478	2.33	4.9374840	99.986
5.600	1419.942	1230.932	1019.937	.1413-006	.2286-008	2.518	2.36	4.9374810	99.986
5.400	1419.941	1230.932	1019.936	.1436-006	.2263-008	2.559	2.39	4.9374781	99.985
5.200	1419.940	1230.931	1019.935	.1459-006	.2286-008	2.599	2.43	4.9374751	99.985
5.000	1419.939	1230.930	1019.934	.1481-006	.2278-008	2.640	2.46	4.9374721	99.985
4.800	1419.938	1230.929	1019.933	.1504-006	.2263-008	2.680	2.50	4.9374692	99.985
4.600	1419.938	1230.928	1019.932	.1527-006	.2278-008	2.721	2.53	4.9374663	99.984
4.400	1419.937	1230.927	1019.931	.1550-006	.2286-008	2.761	2.56	4.9374633	99.984
4.200	1419.936	1230.926	1019.930	.1573-006	.2286-008	2.802	2.60	4.9374603	99.984
4.000	1419.935	1230.925	1019.929	.1595-006	.2255-008	2.842	2.63	4.9374574	99.984
3.800	1419.934	1230.924	1019.928	.1618-006	.2286-008	2.883	2.67	4.9374544	99.983
3.600	1419.933	1230.923	1019.927	.1641-006	.2263-008	2.923	2.70	4.9374514	99.983

FIGURE 3-2. (Continued)

TABLE 3 (CONT.)
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1019.970 - 1419.972 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
3.400	1419.932	1230.922	1019.926	.1663-006	.2286-008	2.964	2.73	4.9374485	99.983
3.200	1419.931	1230.921	1019.925	.1686-006	.2255-008	3.004	2.77	4.9374455	99.983
3.000	1419.930	1230.920	1019.924	.1709-006	.2278-008	3.045	2.80	4.9374425	99.982
2.800	1419.929	1230.919	1019.923	.1732-006	.2286-008	3.085	2.84	4.9374396	99.982
2.600	1419.928	1230.918	1019.922	.1755-006	.2286-008	3.126	2.88	4.9374366	99.982
2.400	1419.927	1230.917	1019.921	.1777-006	.2263-008	3.166	2.92	4.9374337	99.982
2.200	1419.926	1230.916	1019.920	.1800-006	.2286-008	3.207	2.96	4.9374307	99.982
2.000	1419.925	1230.915	1019.919	.1823-006	.2255-008	3.247	2.99	4.9374278	99.981
1.800	1419.925	1230.914	1019.918	.1845-006	.2286-008	3.288	3.03	4.9374248	99.981
1.600	1419.924	1230.913	1019.917	.1868-006	.2278-008	3.328	3.07	4.9374219	99.981
1.400	1419.923	1230.912	1019.916	.1891-006	.2263-008	3.369	3.11	4.9374190	99.981
1.200	1419.922	1230.911	1019.915	.1914-006	.2286-008	3.409	3.15	4.9374160	99.980
1.000	1419.921	1230.910	1019.914	.1936-006	.2278-008	3.450	3.19	4.9374130	99.980
.800	1419.920	1230.910	1019.913	.1959-006	.2286-008	3.490	3.23	4.9374101	99.980
.600	1419.919	1230.909	1019.912	.1982-006	.2263-008	3.531	3.26	4.9374072	99.980
.400	1419.918	1230.908	1019.911	.2005-006	.2286-008	3.571	3.30	4.9374042	99.979
.200	1419.917	1230.907	1019.910	.2028-006	.2278-008	3.612	3.34	4.9374012	99.979
000	1419.916	1230.906	1019.909	.2050-006	.2255-008	3.652	3.38	4.9373983	99.979
-.200	1419.915	1230.905	1019.908	.2073-006	.2286-008	3.693	3.42	4.9373953	99.979

FIGURE 3-2. (Continued)

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FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                  *** DATE 11/24/80, PAGE  67

                                         TABLE  3 (CONT.)
                              - BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

                 - CALCULATED EQUATIONS FOR DROP SIZE CATEGORY  1 (1019.970 - 1419.972 MICRO-M) -

                              SETTLING VELOCITY AS A FUNCTION OF HEIGHT
                 VS(MPS) =   .49373983+001 +   .14773079-004 *H+   .11027818-009 *H**2

                                  HEIGHT AS A FUNCTION OF DISTANCE
                  H(M) =   .11926300+002 + -.59956063+001 *X+   .12372368+000 *X**2

                                  DISTANCE AS A FUNCTION OF HEIGHT
                 X(M) =   .20776707+001 + -.18199798+000 *H+   .65906207-003 *H**2

                      FRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HEIGHT
                      FRACT =   .99986250+000 +   .11651691-004 *H+ -.14707762-009 *H**2

                                 DROP DIAMETER AS A FUNCTION OF HEIGHT
               DROP(MICRON) =   .12309057+004 +   .47817502-002 *H+ -.10877131-006 *H**2

                                  DROP DIAMETER AS A FUNCTION OF TIME
               DROP(MICRON) =   .12309919+004 + -.23591295-001 *T+ -.24819962-005 *T**2
```

FIGURE 3-2. (Continued)

TABLE 4
- CALCULATED VALUES FROM CANOPY PENETRATION MODEL -

DROP SIZE CATEGORY	HGT= 12.0 M FRACT	HGT= 12.0 M DIST(M)	HGT= 10.8 M FRACT	HGT= 10.8 M DIST(M)	HGT= 9.6 M FRACT	HGT= 9.6 M DIST(M)	HGT= 8.4 M FRACT	HGT= 8.4 M DIST(M)	HGT= 7.2 M FRACT	HGT= 7.2 M DIST(M)	HGT= 6.0 M FRACT	HGT= 6.0 M DIST(M)
1	1.00000	.0	.69800	.2	.62600	.4	.52400	.6	.37200	.8	.37200	1.0
2	1.00000	.0	.72000	.2	.66800	.5	.57400	.8	.43600	1.0	.43600	1.3
3	1.00000	.0	.74400	.3	.69600	.6	.61200	.9	.44400	1.2	.44400	1.5
4	1.00000	.0	.73200	.3	.68400	.6	.60800	1.0	.47600	1.3	.47600	1.6
5	1.00000	.0	.67800	.4	.61400	.7	.54600	1.1	.41800	1.5	.41800	1.8
6	1.00000	.0	.80600	.4	.73400	.8	.64200	1.3	.51800	1.7	.51200	2.1
7	1.00000	.0	.81400	.5	.74600	1.0	.64400	1.4	.51400	1.9	.51200	2.4
8	1.00000	.0	.84200	.6	.79000	1.1	.67600	1.7	.51400	2.3	.47800	2.9
9	1.00000	.0	.88800	.7	.82000	1.4	.73400	2.1	.62200	2.8	.53400	3.5
10	1.00000	.0	.93200	.8	.86600	1.7	.78800	2.5	.67200	3.3	.55000	4.2
11	1.00000	.0	1.00000	1.1	.94000	2.1	.81400	3.2	.68600	4.3	.57800	5.5
12	1.00000	.0	.87800	1.3	.79000	2.7	.69200	4.0	.59400	5.4	.50400	6.8
13	1.00000	.0	.99200	1.7	.91200	3.4	.79400	5.1	.69600	6.8	.61000	8.5
14	1.00000	.0	.92200	2.5	.85000	5.0	.77200	7.5	.68400	10.0	.63000	12.6
15	1.00000	.0	.97200	4.7	.91800	9.4	.84800	14.2	.80000	19.2	.73600	24.1
16	1.00000	.0	.26000	64.2	.00000	220.4	.00000	468.6	.00000	808.8	.00000	1241.0

FRACTION/DISTANCE OF MATERIAL REACHING INDICATED HEIGHT

DROP SIZE CATEGORY	HGT= 4.8 M FRACT	HGT= 4.8 M DIST(M)	HGT= 3.6 M FRACT	HGT= 3.6 M DIST(M)	HGT= 2.4 M FRACT	HGT= 2.4 M DIST(M)	HGT= 1.2 M FRACT	HGT= 1.2 M DIST(M)	HGT= .0 M FRACT	HGT= .0 M DIST(M)
1	.30600	1.2	.30600	1.4	.30600	1.7	.30600	1.9	.30600	2.1
2	.34800	1.5	.34800	1.8	.34800	2.1	.34800	2.3	.34800	2.6
3	.33800	1.8	.33800	2.1	.33800	2.4	.33800	2.7	.33800	3.0
4	.35400	2.0	.35400	2.3	.35400	2.6	.35400	3.0	.35400	3.3
5	.33000	2.2	.33000	2.6	.33000	3.0	.33000	3.4	.33000	3.8
6	.38800	2.6	.38800	3.0	.38800	3.5	.38800	3.9	.38800	4.4
7	.41000	2.9	.41000	3.4	.41000	3.9	.41000	4.5	.41000	5.0
8	.36800	3.5	.36800	4.1	.36800	4.7	.36800	5.3	.36800	5.9
9	.37400	4.2	.37400	4.9	.37400	5.7	.37400	6.4	.37400	7.2
10	.36800	5.1	.33000	5.9	.33000	6.8	.33000	7.7	.33000	8.6
11	.41400	6.6	.32400	7.7	.30800	8.9	.30800	10.0	.30800	11.2
12	.38600	8.2	.32400	9.6	.31000	11.0	.31000	12.5	.30800	13.9
13	.56200	10.3	.52400	12.1	.51800	13.9	.51800	15.7	.51800	17.5
14	.56600	15.2	.53800	17.8	.52800	20.5	.52800	23.2	.52800	25.9
15	.71000	29.2	.68000	34.3	.67600	39.5	.67600	44.8	.67600	50.2
16	.00000	1765.3	.00000	2381.6	.00000	3090.0	.00000	3890.3	.00000	4782.7

FIGURE 3-3. Canopy Penetration Model Calculations Listing

penetration model output gives the fraction of drop material that reaches each tenth of the forest canopy height and the horizontal distance from the point of entry to the given tenth of canopy height. This information is printed for each drop size category. If a drop-size category evaporates prior to entering the canopy, the fraction of drop material in the table will be zero.

Dispersion Model Output. This output is controlled by the parameter ISW(4). The user does not have the option of not printing these calculations. An example output listing produced by ISW(4) equal to "1" is shown in Figure 3-4. This figure shows a listing of the calculation of ground-level deposition. The listing gives the units, the maximum value and location of the maximum value followed by the deposition calculated at each receptor location. An output listing for dosage and/or concentration would have the same structure and content.

3.2 USER'S INSTRUCTIONS

3.2.1 Program Description

The FSCBG program is designed to calculate the wake-settling velocity of the spray aircraft, the evaporation of spray drops, the percentage of spray material penetrating to fixed levels within a forest canopy and dosage, concentration and deposition at specified receptor coordinates downwind of multiple spray lines. The FSCBG computer program is written in FORTRAN IV and is designed for use on a UNIVAC 1108 computer. The program requires approximately 24000 words of executable core for instruction and data storage on the UNIVAC 1108. The program requires data card image input (logical unit 5) and print output (logical unit 6). The program consists of a main program and 22 subroutines, (FSDTA,

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TABLE 5

- DEPOSITION (DROPS /SQUARE METER) *-*
- AT A HEIGHT OF .0000 METERS *-*
(MAXIMUM DEPOSITION = .2189868+006 AT X= -75.000, Y= 153.200)

Y AXIS (METERS)	- X AXIS (METERS) -								
	-82.30	-81.40	-80.50	-79.60	-78.60	-77.70	-76.80	-75.90	-75.00
	- DEPOSITION -								
153.20	.206238+006	.202115+006	.203213+006	.205261+006	.206019+006	.207985+006	.213043+006	.212663+006	.218987+006

Y AXIS (METERS)	- X AXIS (METERS) -								
	-74.10	-73.20	-72.20	-71.30	-70.40	-69.50	-68.60	-67.70	-66.80
	- DEPOSITION -								
153.20	.212073+006	.203174+006	.198979+006	.200708+006	.203121+006	.204133+006	.206073+006	.211251+006	.217335+006

Y AXIS (METERS)	- X AXIS (METERS) -								
	-65.80	-64.90	-64.00	-63.10	-62.20	-61.30	-60.40	-59.40	-58.50
	- DEPOSITION -								
153.20	.218262+006	.211396+006	.202440+006	.198056+006	.198865+006	.200595+006	.200937+006	207431+006	.207150+005

Y AXIS (METERS)	- X AXIS (METERS) -								
	-57.60	-56.70	-55.80	-54.90	-53.90	-53.00	-52.10	-51.20	-50.30
	- DEPOSITION -								
153.20	.212278+006	.212052+006	.204519+006	.194920+006	.189837+006	.190550+006	.192015+006	.191822+006	.192370+006

Y AXIS (METERS)	- X AXIS (METERS) -								
	-49.40	-48.50	-47.50	-46.60	-45.70	-44.80	-43.90	-43.00	-42.10
	- DEPOSITION -								
153.20	195935+006	.200136+006	.198588+006	.189073+006	.176977+006	.168953+006	.165190+006	.161549+006	.155426+006

FIGURE 3-4. Dispersion Model Calculations Listing

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TABLE 5 (CONT.)

- DEPOSITION (DROPS /SQUARE METER) *-*
- AT A HEIGHT OF .0000 METERS *-*
(MAXIMUM DEPOSITION = .2189868+006 AT X= -75.000, Y= 153.200)

Y AXIS (METERS)	-41.10	-40.20	-39.30	-38.40	-37.50	-36.60
			- DEPOSITION -			
153.20	.148175+006	.143339+006	.137056+006	.123364+006	.100274+006	.733324+005

FIGURE 3-4. (Continued)

CBGS1, CBGS2, CBGS3, EVPMD, EVPML, REGRS, AVGRD, IOPUT, UNRAN, CANPY, TEST, TESS, CBGS4, CBGS5, FOFX, ERFXS, VRTCL, LNPN1, LNPN2, CBGS6 and TITLR). Although the program is written primarily for use on a UNIVAC 1108 computer, the program is easily adaptable to other computers. The program can be segmented by using the subroutines beginning with CBGS and following non-CBGS subroutines as overlay segments. The program would then have 6 segments in addition to the main program segment.

3.2.2 Control Language and Data Deck Setup

Control Language Requirements. The following illustrates the required executive control statement runstream for a typical run on a UNIVAC 1108 operating system.

1.	@RUN,priority jobid,account,userid,time,pages	
2.	@SYM PRINT$,,device	Optional, used to direct output to a print device
3.	@ASG,A prog-file.	
4.	@ASG,A data-file.	Optional, used only when the FSCBG program input data has been placed in a file or data element within a file.
5.	@ASG,CP print-file. @BRKPT PRINT$/print-file	Optional, used to direct print output to a specific device when running in demand mode
6.	@XQT prog-file.FSCBG	

7. card-input-data

or

@ADD data

or

@ADD data-file.data-name

{ input FSCBG data on card or typed from a terminal

{ FSCBG input data have been placed in a file or element within a file

```
8.  @BRKPT  PRINT$
    @FREE  print-file.
    @SYM   print-file,,device
```

{ Optional, used with 5 above to direct the print output to a specific print device

9. @FIN

where

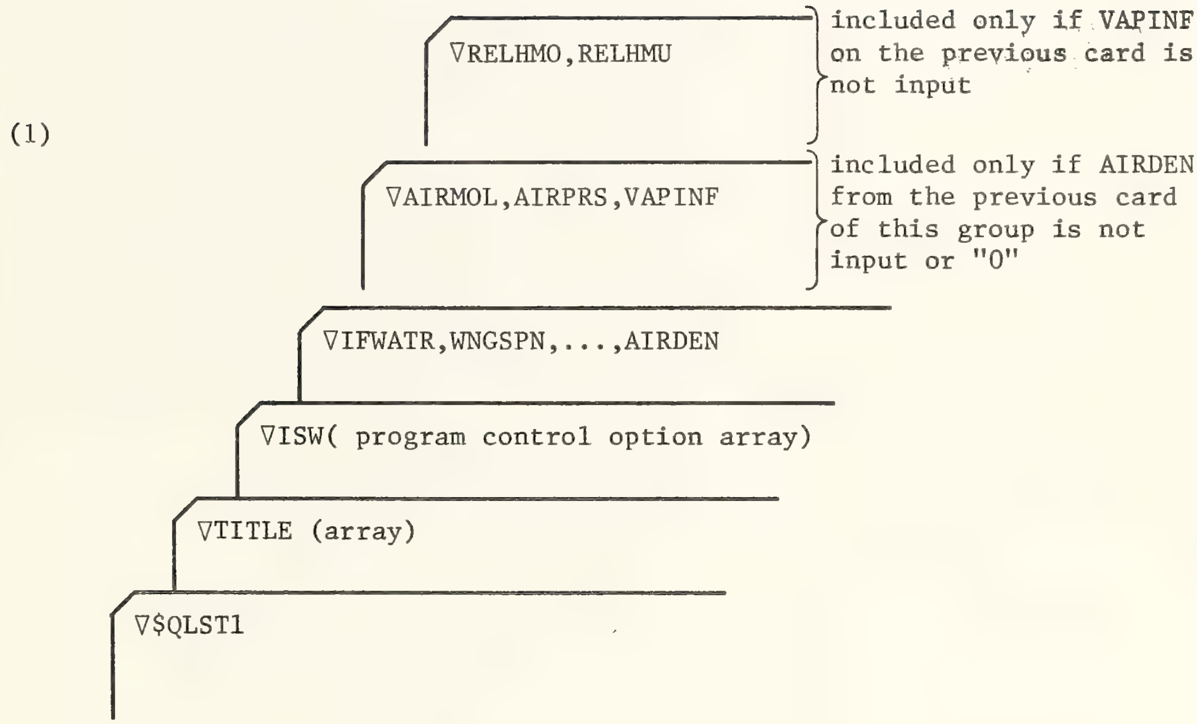
priority	=	job run priority
jobid	=	six-character user supplied job identification
account	=	account number
userid	=	up to 12 character user supplied project or user number
time	=	execution time required in minutes
pages	=	output pages required
device	=	printer symbiont name, onsite or remote, to which you desire the print file to go

prog-file	=	the name of the program file. This illustration assumes the user has assembled and collected the FSCBG program into this file and called the absolute program FSCBG
data-file	=	the name of an optional data file into which the user has placed the input card image data for FSCBG
print-file	=	optional, user supplied, file name to be used for the FSCBG print output file.
card-input-data	=	FSCBG program input card image data defined in Section 3.1.2 and shown in Figure 3-5.

<u>Data Deck Setup</u>. The card image input data required by the FSCBG program depends on the program options desired by the user. The card image input deck may be partitioned into five major groups of card data. Figure 3-5 illustrates the input deck setup. Note that some of the card groups shown may be omitted from the input deck, depending on the program options chosen. The five major input groups are:

1. Required Input data. These data consist of 1 or more data card images that are always included in the input deck. Figure 3-5 shows the 5th and 6th card image of this group are input only if a specific parameter on the preceeding card is zero.

2. Wake Model Input Data. Only one of these two data card images is included in the input deck, depending on ISW(1).



(Required Input Data)

FIGURE 3-5. Input data deck setup for the FSCBG program. (the ∇ smybol means blank or no punch).

(2)

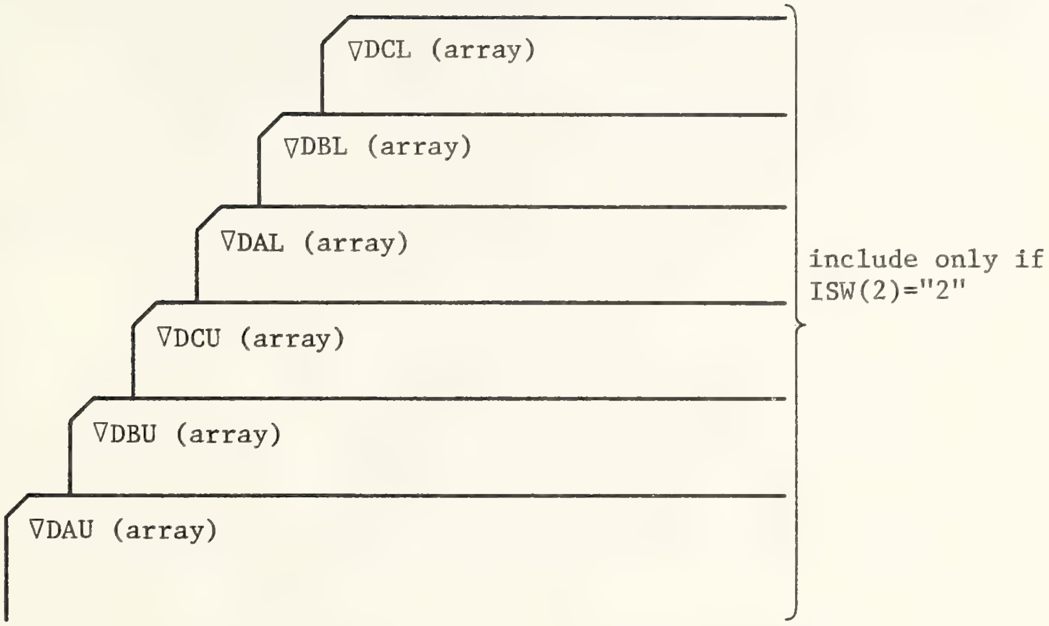
∇WAKVEL — included only if ISW(1)="0"

∇ARCRWT,ARCRSP — included only if ISW(1)="1"

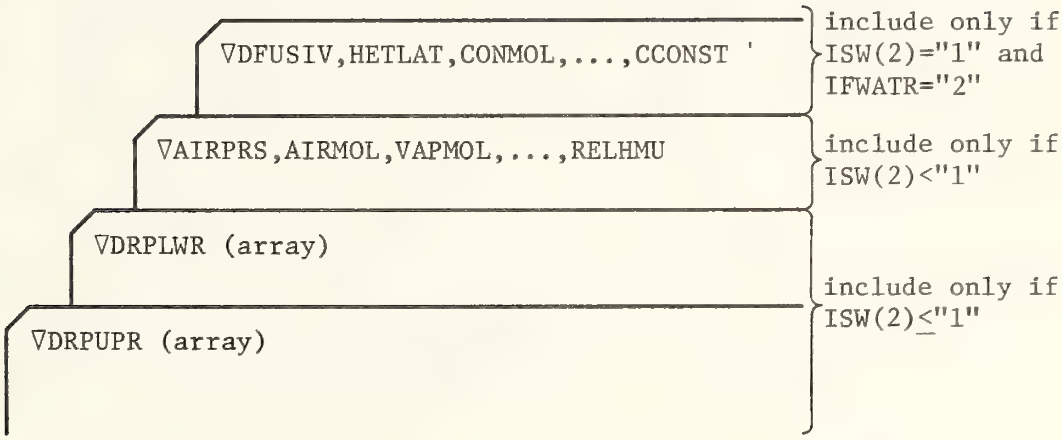
(Wake Model Input Data)

FIGURE 3-5. (Continued)

(the ∇ symbol means blank or no punch)



(3)

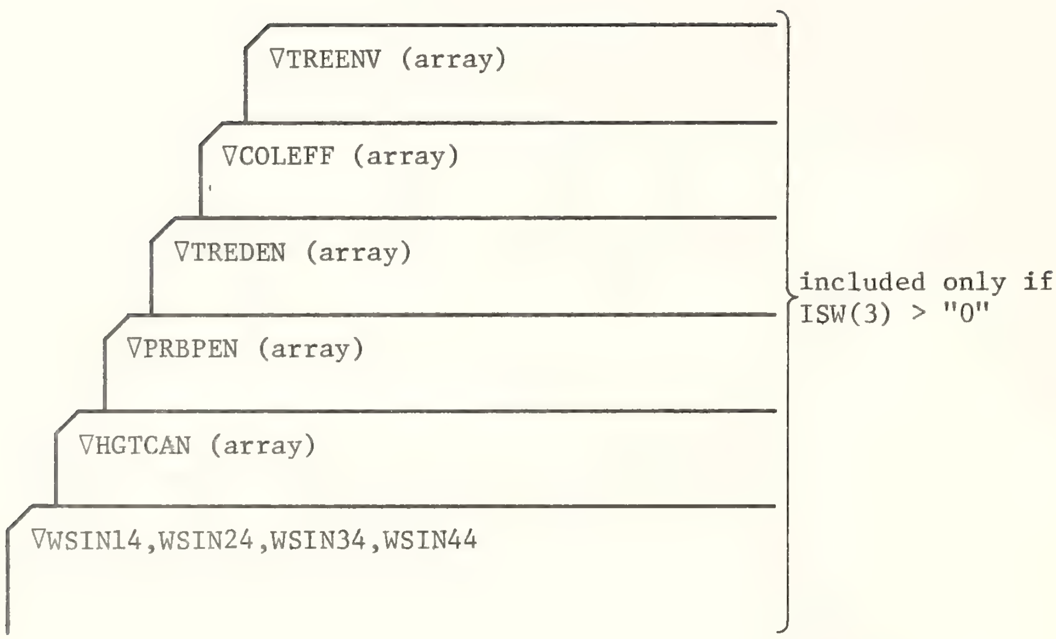


(Evaporation Model Input Data)

FIGURE 3-5. (Continued)

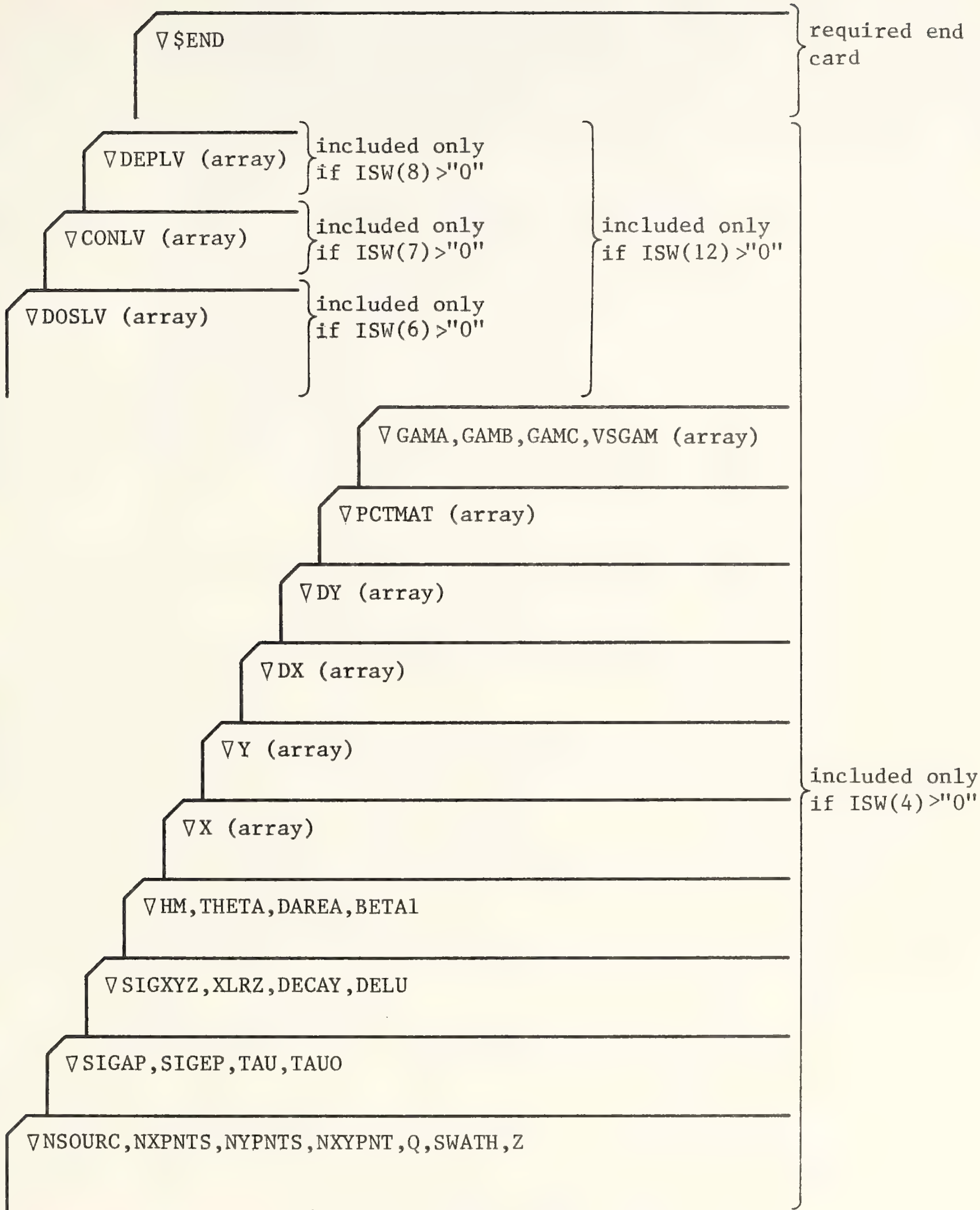
(the ∇ symbol means blank or no punch)

(4)



(Canopy Penetration Model Input Data)

FIGURE 3-5. (Continued)
(the ∇ symbol means blank or no punch)



(Dispersion Model Input Data)

FIGURE 3-5. (Continued)

(the ∇ symbol means blank or no punch)

3. Evaporation Model Input Data. The data cards required in this section of the deck depend on the parameters ISW(2) and IFWATR. Two or more of these data cards will always be included in the input deck.

4. Canopy Penetration Model Input Data. These data cards are included in the input deck only if option ISW(3) is greater than zero.

5. Dispersion Model Input Data. These data cards are included in the input deck only if option ISW(4) is greater than zero. Also, the last three cards of this group depend on ISW(12), ISW(6), ISW(7) and ISW(8).

6. The last data card of the input deck must end with $END.

3.2.3 Input Data Deck Format

The format of the FSCBG program input data is the FORTRAN NAMELIST format and is described in detail in Section 3.2.4 below. The NAMELIST name is QLST1 and the first card of the input deck must have $QLST1 punched in columns 2 through 7 with columns 1 and 8 both blank. The FSCBG input parameter names and values follow on the first and subsequent data cards and are terminated by $END preceded by at least one blank. Column one of the input data deck must never be punched. Figure 3-5 shows the form of the input deck. These data may be entered directly into the runstream following the @XQT card or may be added (@ADD) from a previously created file or symbolic element within a previously created file. Table 3-1 gives the name of each input parameter, limits, default values and a summary description of each parameter. Also, Figure 3-6 gives a set of example input data coding forms for the FSCBG program.

TABLE 3-1

FSCBG PROGRAM INPUT DATA PARAMETERS

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
Optional Program Control Data				
TITLE	N/A	80 Characters	Blanks	Run Titling Information
ISW(1)	0,1	1	0	Wake-settling velocity option- 0=use parameter WAKVEL for the wake settling velocity 1=calculate the wake settling velocity from ARCRWT,WNGSPN, ARCRSP and AIRDEN
ISW(2)	0,1,2	1	0	Evaporation model option- 0=spray drops are not evaporated, but used as input in all model calculations 1=spray drops are evaporated. Evaporated size is used in model calculations 2=user inputs the coefficients of the equations that describe drop size as a function of time
ISW(3)	0,1,2	1	0	Canopy penetration model option- 0=no canopy 1=execute canopy penetration model 2=execute and print calulations from canopy penetration model

* if the parameter is omitted from the input deck, the parameter assumes its respective default value.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
ISW(4)	0,1	1	0	Dispersion models option- 0=no dispersion model 1=execute one or more of the dispersion models, depending on ISW(6),ISW(7) and ISW(8)
ISW(5)	0,1	1	0	Print evaporation model calculations option 0=do not print calculations 1=print calculations
ISW(6)	0,1	1	0	Dosage model option- 0=do not calculate dosage 1=calculate dosage
ISW(7)	0,1	1	0	Concentration model option- 0=do not calculate concentration 1=calculate concentration
ISW(8)	0,1	1	0	Deposition model option 0=do not calculate deposition 1=calculate deposition

* If the parameter is omitted from the input deck, the parameter assumes its reactive default value.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
ISW(9)	0,1,2,3, 4 or 5	1	0	Dosage, concentration and deposition mass output units option- 0=drops 1=micrograms 2=milligrams 3=grams 4=ounces 5=pounds
ISW(10)	0,1	1	0	Dosage time output units option- 0=seconds 1=minutes
ISW(11)	0,1,2,3,4	1	0	Dosage, concentration and deposition volume or area length units output option dos / con / dep / area of coverage 0=m^3 m^3 m^2 m^2 1=ft^3 ft^3 ft^2 ft^2 2=m^3 m^3 acre acre 3=ft^3 ft^3 acre acre 4=m^3 m^3 hectare hectare
ISW(12)	0,1	1	0	Area-coverage option- 0=do not calculate area coverage 1=calculate area-coverage for dosage, concentration and/or deposition, depending on ISW(6),ISW(7) and/or ISW(8)

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
ISW(13)				
ISW(14)				
ISW(15)				
ISW(16)				

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
ISW(17)				
ISW(18)				
ISW(19)				
ISW(20)				

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
Required Input Parameters				
IFWATR	1,2	1	1	Spray liquid base 1=water spray 2=non-water spray
WNGSPN	>0	1	N/A	Aircraft wing span or helicopter rotor diameter (m)
WSOCAN	>0	1	N/A	Wind speed above the canopy
HGTCFT	>0	1	N/A	Height of aircraft above ground (m)
DENLIQ	>0	1	1.0	Density of drop liquid (g cm^{-3})
AIRTPO	N/A	1	N/A	Air temperature above the canopy (^oC)
AIRTPU	N/A	1	AIRTPO	Air temperature below the canopy (^oC)
AIRDEN	>0	1	**	Air density (g cm^{-3})
Parameters that are Required if ISW(1)=0				
WAKVEL	≥ 0	1	N/A	Wake-settling velocity (m s^{-1})

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

** If this parameter is omitted from the input deck, the parameters AIRMOL, AIRPRS and VAPINF are required. Further, if VAPINF is omitted, the parameters RELHMO and RELHMU are required

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
	Parameters that are Required if ISW(1)=1			
ARCRWT	>0	1	N/A	Aircraft weight (kg)
ARCRSP	>0	1	N/A	Aircraft ground-speed (m s^{-1})
Parameters that are Required if ISW(2) $\leq$ 1				
DRPUPR	>0	20	N/A	Upper limit to the drop diameter for each drop size category. Input in descending order of size (micrometers)
DRPLWR	>0	20	DRPUPR***	Lower limit to the drop diameter (micrometers) for each drop size category. Input in descending order of drop size.
Parameters that are Required if ISW(2)=1				
AIRPRS	>0	1	1013.25***	Air pressure (mb)
AIRMOL	>0	1	28.9644***	Molecular weight of air (g $mole^{-1}$)
VAPMOL	>0	1	18.015***	Molecular weight of evaporating vapor (g $mole^{-1}$)
RELHMO	>0	1	N/A	Relative humidity above the canopy (%)
RELHMU	$\geq$0	1	RELHMO***	Relative humidity below the canopy (%)

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value is used if the parameter equals 0 or is omitted.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
Parameters that are Required if ISW(2)=1 and IFWATR=2				
DFUSIV	>0	1	****	Diffusivity of the evaporating vapor into air at the drop temperature (cm^2 s^{-1})
HETLAT	>0	1	****	Latent heat of vaporization (cal $mole^{-1}$)
CONMOL	>0	1	****	Molal concentration of the air-liquid mixture (moles cm^{-3})
THERMC	>0	1	****	Thermal conductivity of the vapor into air at the drop temperature (cal s^{-1} cm^{-1} ^oK)
VAPINF	$\geq$0	1	****	Vapor pressure of the evaporating vapor at infinity (mb)
BCONST, CCONST	>0, >0	1,1	21.07,*** 5249.9	Vapor pressure equation constants

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value is used if the parameter is 0 or omitted.

**** The default value for these parmeters is calculated assuming similar to water.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
Parameters that are Required if ISW(2)=2				
DAU,DBU, DCU	N/A	20,20 20	N/A	Coefficients of the equation of drop size as a function of time for each drop size category above the canopy $D = DAU + DBU \cdot t + DCU \cdot t^2$ Input each array in descending order of drop size
DAL,DBL, DCL	N/A	20,20 20	DAU,DBU, DCU	Coefficients of the equation of drop size as a function of time for each drop-size category below the canopy $D = DAL + DBL \cdot t + DCL \cdot t^2$ Input each array in descending order of drop size
Parameters that are Required if ISW(3)>0				
WSIN44	>0	1	WSOCAN***	Wind speed in top quarter of canopy ($m\ s^{-1}$)
WSIN34	>0	1	WSIN44***	Wind speed in third quarter of canopy ($m\ s^{-1}$)
WSIN24	>0	1	WSIN34***	Wind speed in second quarter of canopy ($m\ s^{-1}$)
WSIN14	>0	1	WSIN24***	Wind speed in bottom quarter of canopy ($m\ s^{-1}$)

* if the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value is used if the parameter is 0 or omitted.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
HGTCAN	>0	3	N/A	Height of each forest canopy height class (m)
PRBPEN	>0 & ≤1	3	N/A	Probability of drop penetration (fraction) for each canopy height class
TREDEN	>0	3	N/A	Tree density (stems $acre^{-1}$) for each canopy height class
COLEFF	>0 & ≤1 or <0	20 or 3	-13	Collection efficiencies (fraction) for each drop size category or Diameters (cm) of the vegetative elements representative of each canopy height class. Input as negative values
TREENV	>0	100	N/A	Tree envelope (width) (m) at each meter of tree height for each canopy height class from 1 meter above the ground to HGTCAN. Input HGTCAN(1) values, followed by HGTCAN(2) values, followed by HGTCAN(3) values
Parameters that are Required if ISW(4)>0				
NSOURC	>0 & ≤100	1	1***	Number of line sources or aircraft spray lines

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value is used if the parameter is 0 or omitted.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
NXPNTS	****	1	0	Number of X (east-west) coordinates in receptor grid system
NYPNTS	****	1	0	Number Y (north-south) coordinates in receptor grid system
NXYPNT	****	1	0	Number of discrete (arbitrarily placed) receptors
Q	>0	1	1***	Emission of spray material in g m^{-1} if SWATH=0, in gal $acre^{-1}$ if SWATH>0
SWATH	≥ 0	1	0***	Distance between spray lines (m) if Q is in gallons/acre, otherwise omit or input as 0
Z	≥ 0	1	0***	Height of dosage, concentration and deposition calculations (m)
SIGAP	>0	1	N/A	Standard deviation of the wind azimuth angle (radians or degrees)
SIGEP	>0	1	N/A	Standard deviation of the wind elevation angle (radians or degrees)
TAU	>0	1	2.5***	Time to spray cloud stabilization (s)

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value is used if the parameter is 0 or omitted.

**** $100 \geq$ NXPNTS+NYPNTS+2*NXYPNT and $737 \geq$ NXPNTS*NYPNTS+NXYPNT.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
TAUO	>0	1	600***	Measurement time for SIGAP(s)
SIGXYZ	>0	1	WNGSPN/4.3***	Standard deviation of the source material along the spray line (m)
DECAY	≥0	1	0***	Coefficient of time dependent exponential decay for the removal of material due to physical or chemical processes
XLRZ	≥0	1	****	Lateral and vertical reference distance (m)
DELU	≥0	1	0	Wind-speed shear above the canopy (m s^{-1})
HM	>0	1	N/A	Surface mixing layer height (m)
THETA	≥0 & ≤360	1	N/A	Wind direction (degrees clockwise from north)
DAREA	>0	1	10000***	Area assignment for discrete receptor points (m^2)

* If the parameter is omitted from the imput deck, the parameter assumes its respective default value.

*** Default value if the parameter is 0 or omitted.

**** This parameter is normally calculated by the program. However, if XLRZ is input ≥ 0, the input value is used.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
BETA1	≥ 0	1	0***	Ratio of Lagrangrian to Eulerian time-scales used in the correction factor on SIGEP and SIGAP for crossing-trajectory effects of heavy drops (fraction). Recommended value is 1.0, if used
X	N/A	NXPNTS +NXYPNT	N/A	X axis of receptor grid system followed by discrete receptor X coordinates. X axis should be in ascending order of value (m)
Y	N/A	NYPNTS +NXYPNT	N/A	Y axis of receptor grid system followed by discrete receptor coordinates. Y axis should be in ascending order of value (m)
DX	N/A	2*NSOURC	N/A	Start and end X coordinate of each source (m)
DY	N/A	2*NSOURC	N/A	Start and end Y coordinate of each source (m)
PCTMAT	≥ 0 & ≤ 1	20	N/A	Fraction of total spray material in each drop-size category
VSGAM	>0	2	.04, .012	Settling velocities that divide the curve of surface reflection coefficient as a function of settling velocity into three curves ($m\ s^{-1}$)

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value if the parameter is 0 or omitted.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
GAMA,GAMB, GAMC	N/A	3 each	GAMA=.75, .83465302, .91639996 GAMB=-2.5, -6.9031391, -22.357124 GAMC=0.0, 57.409256, 821.42651	Coefficients of equations using the surface reflection coefficient as a function of drop settling velocity VS>VSGAM(1) uses GAMA(1), GAMB(1) & GAMC(1) VSGAM(1)>VS>VSGAM(2) uses GAMA(2), GAMB(2) & GAMC(2) VSGAM(2)>VS uses GAMA(3), GAMB(3) & GAMC(3)
Parameters that are Required if ISW(12)>0				
DOSLV	N/A	10	N/A	Dosage levels in units same as output dosage for dosage area-coverage (required only if ISW(6)>0)
CONLV	N/A	10	N/A	Concentration levels in units same as output concentration for concentration area-coverage (required only if ISW(7)>0)
DEPLV	N/A	10	N/A	Deposition levels in units same as output deposition for deposition area-coverage (required only if ISW(8)>0)

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

FSCBG INPUT DATA CODING FORM

PROJECT | NAME
DATE | SHEET 1 OF 5

CARD GROUP NUMBER | 0=numeric, Ø=alpha | X = do not punch | DATA CARD COLUMN 1–80

- Required Input Parameters -

```
$QLST1
TITLE=  H
ISW=
IFWATR=  ,WNGSPN=        ,WSØCAN=        ,HGTCFT=        ,DENLIQ=
AIRTPØ=        ,AIRTPU=        ,AIRDEN=
```

- Required if AIRDEN is Omitted -

```
AIRPRS=        ,AIRMØL=        ,VAPINF=
```

- Required if AIRDEN and VAPINF are both omitted -

```
RELHMØ=        ,RELHMU=
```

- Required if ISW(1)="0" (wake settling velocity model) -

```
WAKVEL=
```

- Required if ISW(1)="1" (wake settling velocity model)

```
ARCRWT=        ,ARCRSP=
```

- Required if ISW(2)≤"1"(evaporation model)

```
DRPUPR=

DRPLWR=

```

FIGURE 3-6. Example FSCBG Input Data Coding Forms.

FSCBG INPUT DATA CODING FORM

PROJECT

NAME

DATE SHEET 2 OF 5

CARD GROUP NUMBER

0=numeric
Ø=alpha

X = do not punch

DATA CARD COLUMN

- Required if ISW(2)="1" (evaporation model) -

AIRPRS= ,AIRMØL= ,VAPMØL= ,RELHMØ= ,RELHMU=

- Required if ISW(2)="1" and IFWATR="2" (evaporation model) -

DFUSIV= ,HETLAT= ,CØNMØL= ,THERMC= ,VAPINF=

BCØNST= ,CCØNST=

- Required if ISW(2)="2" (evaporation model) -

DAU=

DBU=

DCU=

DAL=

DBL=

DCL=

FIGURE 3-6. (Continued)

FSCBG INPUT DATA CODING FORM

PROJECT

NAME

DATE SHEET 3 OF 5

CARD GROUP NUMBER

0=numeric
Ø=alpha

X = do not punch

DATA CARD COLUMN

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

- Required if ISW(3)>"0" (canopy penetration model) -

WSIN14= WSIN24= WSIN34= WSIN44=

HGTCAN= PRBPEN=

TREDEN=

CØLEFF=

TREENV=

FIGURE 3-6. (Continued)

FSCBG INPUT DATA CODING FORM

PROJECT		NAME
		DATE SHEET 4 OF 5

CARD GROUP NUMBER | 0=numeric, Ø=alpha | X = do not punch | DATA CARD COLUMN 1–80

- Required if ISW(4)>"0" (dispersion model) -

NSØURC= , NXPNTS= , NYPNTS= , NXYPNT= , Q= , SWATH= ,

Z= , SIGAP= , SIGEP= , TAU= , TAUØ= , SIGXYZ= ,

XLRZ= , DELU= , HM= , THETA= , DAREA= , BETA1= ,

X= , , , , , , , , , ,

, , , , , , , , , ,

Y= , , , , , , , , , ,

, , , , , , , , , ,

DX= , , , , , , , , , ,

, , , , , , , , , ,

DY= , , , , , , , , , ,

, , , , , , , , , ,

PCTMAT= , , , , , , , , , , ,

, , , , , , , , , , ,

GAMA= , , , GAMB = , , ,

GAMC= , , , VSGAM= , ,

FIGURE 3-6. (Continued)

FSCBG INPUT DATA CODING FORM

PROJECT		NAME
		DATE SHEET 5 OF 5

CARD GROUP NUMBER — 0=numeric, Ø=alpha, X = do not punch — DATA CARD COLUMN 1–80

- Required if ISW(4)>"0", ISW(6)>"0" and ISW(12)>"0" (dosage area coverage) -

DØSLV=

- Required if ISW(4)>"0", ISW(7)>"0" and ISW(12)>"0" (concentration area coverage) -

CØNLV=

- Required if ISW(4)>"0", ISW(8)>"0" and ISW(12)>"0" (deposition area coverage) -

DEPLV=

- Required End Card -

$END

FIGURE 3-6. (Continued)

FSCBG INPUT DATA CODING FORM

PROJECT

NAME

DATE SHEET OF

CARD GROUP NUMBER

0=numeric
Ø=alpha

X = do not punch

DATA CARD COLUMN

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

FIGURE 3-6. (Continued)

3.2.4 NAMELIST Input Format

The FSCBG computer program uses the FORTRAN NAMELIST DATA input format for input of control data. The namelist input data must be in a specific form in order to be read using a NAMELIST list. The first character (column 1) in each input card must be blank. The first card in the namelist deck contains the namelist name QLST1, preceded by the character $ (QLST1). The $ must be punched in column 2 and the name QLST1 must be followed by at least one blank. The last card in the input deck contains $END, preceded by at least one blank, to terminate the control data input. Use the character & rather than $ on IBM computers. The form of the data items within the deck may be:

a. Variable Name = Constant, -- The variable name may be a subscripted array name (ISW(4)) or a single variable name WAKVEL. Subscripts must be constants. The Constant may be an integer (whole number) or may be real (fractional part) and is terminated by a comma. Integer input parameter variables are those that begin with the letter I, J, K, L, M or N and must have a whole number Constant value. Real input parameters are those variables that begin with any other letter and may have a fractional part (45.342). Also, real parameters may have a Constant of the form X.XXEII, where E denotes the power of 10 of the value.

Example:

```
IFWATR=1,WNGSPN=9.144,WSOCAN=4.6,
HGTCFT=30,
```

b. Array Name = Set of Constants, -- The Array Name is not subscripted. The Set of Constants consists of constants of the type real or integer, depending on the Array Name, and all are separated by commas. The number of constants must be less than or equal to the

maximum allowed by the program for the specific Array Name. Successive occurrence of the same constant value can be represented in the form k*Constant.

Example:

```
ISW=0,1,2,1,1,2*0,1,1,
DRPUPR=414.0,365,341,320,304,282,265,249,
```

c. Array Name = nnH ... Hollerith String ..., -- The Array Name is not subscripted (or is a simple Variable Name). The Hollerith String consists of labeling information or format information of any characters desired. There are exactly nn characters of information (including blanks) following the H and preceding a terminating comma. The only FSCBG input parameter that may use this form is TITLE.

Example:

```
TITLE=37HRUN TITLE FOR FSCBG PROGRAM EXECUTION,
```

Input parameters and array elements that are not included (punched) in the input deck assume their respective default values.

3.2.5 Program Run Time and Page Output Estimates

This section gives approximations to the computer run time and page output for the FSCBG program. Because of the variability of problem runs and input parameters, the equations in this section are meant only to give an approximation of the upper limit of the time and page usage function.

a. Run Time. The run time required for a problem run is given by

$$\text{Time (Seconds)} \cong N_d \Big[(f_1 \cdot H_o + f_2) + (f_3 \cdot H_u + f_4) + \big(N_c \cdot (f_5 \cdot H_u/N_t + f_6)\big) + \big((N_x \cdot N_y + N_{xy}) \cdot N_s \cdot (f_7 \cdot H_o + f_8)\big)\Big] \qquad (3\text{-}14)$$

where

N_d = the number of drop size categories

H_o = the humidity above the canopy (RELHMO)

H_u = the humidity below the canopy (RELHMU)

N_c = the number of tree height classes (multi-storied) canopy

N_t = the number of trees (stems) per acre (TREDEN)

N_x = the number of receptors in the grid system x axis (NXPNTS)

N_y = the number of receptors in the grid system y axis (NYPNTS)

N_{xy} = the number of discrete receptors (NXYPNT)

N_s = the number of sources (NSOURC)

$$f_1 \cong \begin{cases} 2.3\text{x}10^{-3} & ; \text{ if ISW(2)="1"} \\ 0 & ; \text{ if ISW(2)}\neq\text{"1"} \end{cases}$$

$$f_2 \cong \begin{cases} 1.6 & ; \text{ if ISW(2)="1"} \\ 0.4 & ; \text{ if ISW(2)}\neq\text{"1"} \end{cases}$$

$$f_3 \cong \begin{cases} 1.9\text{x}10^{-4} & ;\ \text{if ISW(2)="1" \& ISW(3)>"0"} \\ 0 & ;\ \text{if ISW(2)}\neq\text{"1" or ISW(3)="0"} \end{cases}$$

$$f_4 \cong \begin{cases} 0.5 & ;\ \text{if ISW(2)="1" \& ISW(3)>"0"} \\ 0 & ;\ \text{if ISW(3)="0"} \\ .90 & ;\ \text{if ISW(2)}\neq\text{"1" \& ISW(3)>"0"} \end{cases}$$

$$f_5 \cong \begin{cases} 2.7 & ;\ \text{if ISW(3)>"0"} \\ 0 & ;\ \text{if ISW(3)="0"} \end{cases}$$

$$f_6 = \begin{cases} 9.0 & ;\ \text{if ISW(3)>"0"} \\ 0 & ;\ \text{if ISW(3)="0"} \end{cases}$$

$$f_7 \cong 2.0\text{x}10^{-4}$$

$$f_8 = 5.0\text{x}10^{-3}$$

The user should add any other time expected from other processing within the job to the estimate calculated via Equation 3-14. Also, if the values of f_i above are not appropriate for your computer, recalculate and replace the f_i values.

b. Page Output. The number of pages of print output from the FSCBG program depends on the problem being run and is given by

$$\text{Pages} \cong A + B + C + D \qquad (3\text{-}15)$$

where

$$A = \begin{cases} 1 & ;\ \text{if ISW(5)="0"} \\ 2 + 4 \cdot N_d & ;\ \text{if ISW(5)>"0"} \end{cases}$$

$$B = \begin{cases} 1 & ;\ \text{if ISW(5)="0" or ISW(3)="0"} \\ 2 + 3 \cdot N_d & ;\ \text{if ISW(5)>"0" \& ISW(3)>"0"} \\ 2 & ;\ \text{if ISW(5)="0" \& ISW(3)>"0"} \end{cases}$$

$$C^* = \begin{cases} 0 & ;\ \text{if ISW(4)="0"} \\ 1 + \left[\dfrac{5 + \left[\dfrac{N_x}{9}\right] \cdot \left(9 + N_y\right)}{57}\right] \cdot \left(\text{ISW(6)+ISW(7)+ISW(8)}\right) & ;\ \text{if ISW(4)>"0"} \end{cases}$$

$$D = \begin{cases} 0 & ;\ \text{If ISW(12)="0"} \\ \text{ISW(6)+ISW(7)+ISW(8)} & ;\ \text{if ISW(12)>"0"} \end{cases}$$

The user should add any other pages expected from the remainder of the job to the estimate calculated via Equation 3-15.

---

* The [ ] symbols mean to round up to the next integer if there is any fractional part.

SECTION 4

FSCBG EXAMPLE PROBLEM

4.1 FSCBG EXAMPLE PROBLEM DESCRIPTION

As we have indicated, the FSCBG model computer program can be used to calculate the deposition of drops within and below forest canopies for comparison with measurements. In this example problem, we use the dispersion and deposition models to calculate drop deposition along a line of deposition card samplers placed at ground level beneath a southern slash pine seed orchard canopy. A schematic diagram of the orchard and position of the card sampling line is shown in Figure 4-1. The rows of trees are separated by 30 feet and the spacing between stems along each row is 15 feet. The spray aircraft, a Stearman biplane, flies north and south between rows of trees beginning between rows 11 and 12 and ending between rows 6 and 7. The aircraft is assumed to fly at an altitude of 60 feet above ground and to spray a water-based pesticide at a rate of 57.33 grams per meter. The rectangular coordinate system used in defining the problem has its origin at the first tree in row 1 shown at the lower right-hand corner of Figure 4-1.

Meteorological Input Parameters

For the example problem, which is based in part on an actual experiment conducted by the Forest Service, we have assumed that meteorological measurements were made above the canopy using a bidirectional wind sensor and a temperature sensor mounted on a 18-meter tower. An analysis of the recorded wind azimuth and elevation data over a 10-minute measurement period (τ_o=600 seconds) beginning at the time the aircraft started to release the spray material yielded estimates of the standard deviations of the wind azimuth angle (σ_A) and wind elevation angle (σ_E) shown in Table 4-1. The mean wind direction (θ) and wind speed ($\bar{u}$) shown in

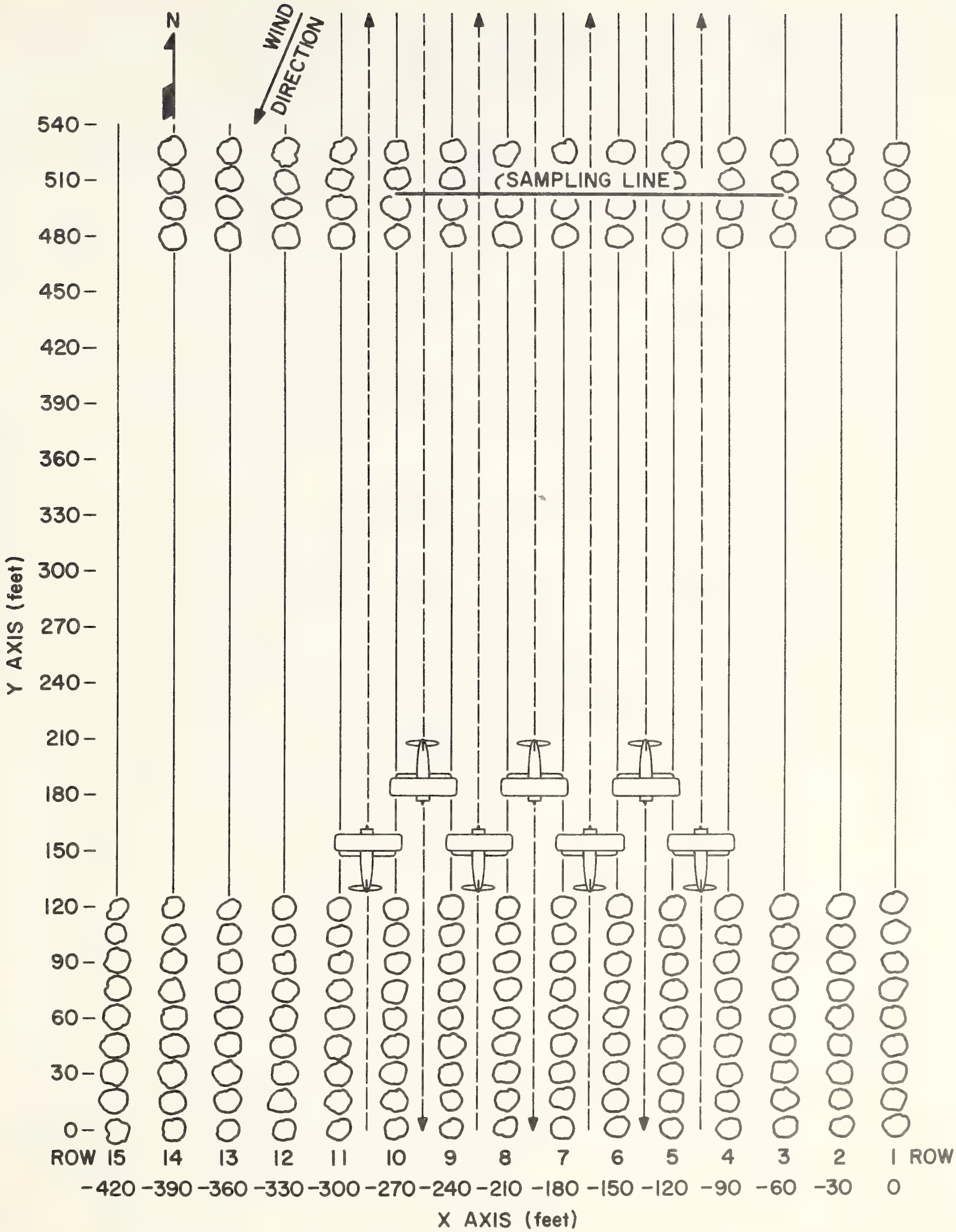


FIGURE 4-1. Example spray problem design.

TABLE 4-1

METEOROLOGICAL INPUT PARAMETERS

Parameter	Program Symbol	Value
$\sigma_A\{\tau_o=600s\}$ (deg)	SIGAP	14.1
σ_E (deg)	SIGEP	11.7
H_m (m)	HM	1000
$\bar{u}$ (m s^{-1})	WSØCAN	1.02
θ (deg)	THETA	23
$\Delta\bar{u}$ (m s^{-1})	DELU	0
P_A (mb)	AIRPRS	1013.25
RH (%)	RELHMØ	98.9
T_A (^oC)	AIRTPØ	14.4
$\bar{u}_{c;1}$ (m s^{-1})	WSIN14	0.95
$\bar{u}_{c;2}$ (m s^{-1})	WSIN24	0.84
$u_{c;3}$ (m s^{-1})	WSIN34	0.82
$u_{c;4}$(m s^{-1})	WSIN44	0.90

Table 4-1 were also estimated for the 10-minute period from the wind sensor. The wind speed shear ($\Delta\bar{u}$) above the canopy was set equal to zero because wind speed was measured only at a single height and furthermore the shear was not expected to have a significant influence on the calculations. The temperature above the canopy (T_A) was 14.4 degrees Celsius. The relative humidity (RH) was measured near ground level. The measured values of air temperature and relative humidity shown in Table 4-1 were assumed in the example problem to represent the temperature and relative humidity both above and within the canopy. The wind speeds within the canopy ($\bar{u}_{c,k}$) shown in the table are based on a normalized height profile for winds in an isolated conifer stand presented by Fritschen, et al. (1970).

Source Input Parameters

Source input parameters used in the model calculations are shown in Table 4-2. The source dimension σ_o was determined form observations that the spray cloud quickly attained a dimension equal to about 1.5 wingspans behind the aircraft. The value of σ_o was determined by dividing this dimension by 4.3 (σ_o=1.5b/4.3) under the assumptions that the distribution of material within the spray cloud was Gaussian and that the visible edge of the cloud represented the point at which the concentration was one-tenth the concentration at the cloud centroid. The aircraft air speed was approximately 90 miles per hour (40.2 m s^{-1}) along the flight lines shown in Figure 4-1. The flight lines were longer than shown in the schematic diagram, each line actually extending from 384.3 meters south (y=-384.3 m) to 370 meters north (y=370.3) of the first tree in Row 1.

Table 4-3 shows the spray drop-size distribution used in the example calculations. This distribution is based on drop-size measurements made during trials in which the Stearman aircraft disseminated material over a sampling line in an open area.

TABLE 4-2

SOURCE INPUT PARAMETERS

Parameter	Program Symbol	Value
Q (g m^{-1})	Q	57.33
H (m)	HGTCFT	18.1
σ_o (m)	SIGXYZ	4.0
W_a (kg)	ARCWGT	1406
b (m)	WNGSPN	11.48
V_a (m s^{-1})	ARCRSP	40.2

TABLE 4-3

SPRAY DISTRIBUTION PARAMETERS

Drop Upper Limit (m) DRPUPR	Drop Lower Limit (m) DRPLWR	Fraction of Material In Drop-Size Category PCTMAT
1420	1020	0.01
1020	840	0.02
840	742	0.03
742	667	0.04
667	577	0.10
577	514	0.10
514	456	0.10
456	351	0.20
351	302	0.10
302	253	0.10
253	200	0.10
200	169	0.04
169	135	0.03
135	100	0.02
100	51.6	0.009
51.6	20.0	0.001

Forest Description Parameters

Forest description parameters for the example problem are shown in Table 4-4. Since the spacing between trees is 15 feet along the rows and there is 30 feet between rows, the tree density is

$$D_t = \frac{1 \text{ stem}}{(30x15) \text{ ft}^2} \times \frac{43560 \text{ ft}^2}{\text{acre}} = \frac{96.8 \text{ stems}}{\text{acre}}$$

The average measured height of the trees (H_c) in the vicinity of the sampling line was 12 meters. The tree widths W_i for heights from 1 to 12 meters were obtained by averaging measurements made of four typical trees near the sampling line. In the calculations, the program was set to calculate impaction efficiencies (E_j) from Equation (2-77) using a default value of s equal to 13 centimeters.

4.2 FSCBG EXAMPLE PROBLEM INPUT DATA

The input data used for this example problem are shown in Figure 4-2 coded on example coding forms identical to those shown in Section 3. Parameters and arrays on the coding forms that are crossed out indicate parameters that are not required (WAKVEL), were previously specified (RELHMO on sheet 2), are being defaulted (AIRTPU) or are trailing comma's that have no associated coded value. The first data card image begins with $QLST1 (the name of the NAMELIST) and the deck ends with $END. The second input card shows the 47 character title. Following the title the program option switch ISW is coded. The option switch values shown in Figure 4-2 specify that the program is to calculate the wake-settling velocity, that spray drops are to be evaporated, a canopy is used and print output from the canopy model is desired, dispersion modeling is to be done, evaporation model results are to be printed,

TABLE 4-4

FOREST DESCRIPTION PARAMETERS

Parameter	Program Symbol	Value
D_t (stems acre^{-1})	TREDEN	98.6
H_c (m)	HGTCAN	12
PRPEN	PRPEN	0.38
W_i i=1	TREENV	0.21
2		0.19
3		0.19
4		3.8
5		6.6
6		6.2
7		5.8
8		6.4
9		5.0
10		4.0
11		3.3
12		1.6

FSCBG INPUT DATA CODING FORM

PROJECT | NAME
DATE | SHEET 1 OF 5

CARD GROUP NUMBER | 0=numeric, Ø=alpha | X = do not punch | DATA CARD COLUMN 1–80

- Required Input Parameters -

```
$GLST1
TITLE=47HFSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY,
ISW=1,1,2,1,1,0,0,1,0,0,0,0,
IFWATR=1,WNGSPN=11.48,WSØCAN=1.02,HGTCFT=18.1,DENLIQ=
AIRTPØ=14.4,AIRTPU=,AIRDEN=
```

- Required if AIRDEN is Omitted -

```
AIRPRS=,AIRMØL=,VAPINF=,
```

- Required if AIRDEN and VAPINF are both omitted -

```
RELHMØ=98.9,RELHMU=,
```

- Required if ISW(1)="0" (wake settling velocity model) -

```
WAKVEL=,
```

- Required if ISW(1)="1" (wake settling velocity model)

```
ARCRWT=1406,ARCRSP=40.2,
```

- Required if ISW(2)≤"1"(evaporation model)

```
DRPUPR=1420,1020,840,742,667,577,514,456,351,302,
253,200,169,135,100,51.6,
DRPLWR=1020,840,742,667,577,514,456,351,302,253,
200,169,135,100,51.6,20,
```

FIGURE 4-2. FSCBG Example Problem Input Data

FSCBG INPUT DATA CODING FORM

PROJECT

NAME

DATE SHEET 2 OF 5

CARD GROUP NUMBER

0=numeric
Ø=alpha

X = do not punch

DATA CARD COLUMN

- Required if ISW(2)="1" (evaporation model) -

AIRPRS= ,AIRMØL= ,VAPMØL= ,RELHMØ= ,RELHMU= ,

- Required if ISW(2)="1" and IFWATR="2" (evaporation model) -

DFUSIV= ,HETLAT= ,CØNMØL= ,THERMC= ,VAPINF= ,

BCØNST= ,CCØNST= ,

- Required if ISW(2)="2" (evaporation model) -

DAU=

DBU=

DCU=

DAL=

DBL=

DCL=

FIGURE 4-2. (Continued)

FSCBG INPUT DATA CODING FORM

PROJECT

NAME

DATE SHEET 3 OF 5

CARD GROUP NUMBER

0=numeric
Ø=alpha

╳ = do not punch

DATA CARD COLUMN

- Required if ISW(3)>"0" (canopy penetration model) -

```
WSIN14=     .95,WSIN24=     .84,WSIN34=     .82,WSIN44=     .90,
HGTCAN=     12,            ,PRBPEN=     .38,
TREDEN=   96.8,
CØLEFF=
TRENV=     .21,     .19,     .19,    3.8,    6.6,    6.2,    5.8,    6.4,    5.0,    4.0,
     3.3,    1.6,
```

FIGURE 4-2. (Continued)

FSCBG INPUT DATA CODING FORM

PROJECT | NAME | DATE | SHEET 4 OF 5

CARD GROUP NUMBER — 0=numeric, Ø=alpha — X = do not punch — DATA CARD COLUMN 1–80

- Required if ISW(4)>"0" (dispersion model) -

```
NSØURC=   7,NXPNTS= 51,NYPNTS=  1,NXYPNT=     ,Q=57.33       ,SWATH=     ,
Z=         ,SIGAP=  14.1,SIGEP=  11.7,TAU=       ,TAUØ=      ,SIGXYZ=   4.0,
XLRZ=      ,DELU=        ,HM=  1000,THETA=    23,DAREA=       ,BETA1=       ,
X= -82.3, -81.4, -80.5, -79.6, -78.6, -77.7, -76.8, -75.8, -75.0, -74.1, -73.2,
   -72.2, -71.3, -70.4, -69.5, -68.6, -67.7, -66.8, -65.8, -64.9, -64.0, -63.1,
Y= 153.2,
DX=-86.9, -86.9, -77.7, -77.7, -68.6, -68.6, -59.4, -59.4, -50.3, -50.3, -41.1,
   -41.1,   -32,   -32,
DY=370.3,-384.3, 370.3,-384.3, 370.3,-384.3, 370.3,-384.3, 370.3,-384.3, 370.3,
  -384.3, 370.3,-384.3,
PCTMAT=   .01,   .02,   .03,   .04,    .1,    .1,    .1,    .2,    .1,    .1,
   .1,   .04,   .03,   .02,  .009,  .001,
GAMA=                         ,GAMB =
GAMC=                         ,VSGAM=
```

FIGURE 4-2. (Continued)

FSCBG INPUT DATA CODING FORM

PROJECT

NAME

DATE SHEET 5 OF 5

CARD GROUP NUMBER

0=numeric
Ø=alpha

X = do not punch

DATA CARD COLUMN

- Required if ISW(4)>"0", ISW(6)>"0" and ISW(12)>"0" (dosage area coverage) -

DØSLV=

- Required if ISW(4)>"0", ISW(7)>"0" and ISW(12)>"0" (concentration area coverage) -

CØNLV=

- Required if ISW(4)>"0", ISW(8)>"0" and ISW(12)>"0" (deposition area coverage) -

DEPLV=

- Required End Card -

$END

FIGURE 4-2. (Continued)

FSCBG INPUT DATA CODING FORM

PROJECT

NAME

DATE SHEET OF

CARD GROUP NUMBER

0=numeric
Ø=alpha

X = do not punch

DATA CARD COLUMN

1 2 3 4 5 6 7 8 9 10 ... 80

(continuation of X axis input values)

```
-62.2,-61.3,-60.4,-59.4,-58.5,-57.6,-56.7,-55.8,-54.9,-53.9,-53,-52.1,-51.2,
-50.3,-49.4,-48.5,-47.5,-46.6,-45.7,-44.8,-43.9,-43,-42.1,-41.1,-40.2,-39.3,
-38.4,-37.5,-36.6,
```

FIGURE 4-2. (Continued)

dosage is not calculated, concentration is not calculated, deposition is to be calculated, output mass units are drops, dosage time units do not apply, length output units are meters and, finally, area coverage is not calculated. Following the program options are the remainder of the "required" input parameters. A "required" parameter means that a value for the parameter must be either input or defaulted and does not mean that punching a value for the parameter is required. For example, the parameters DENLIQ, AIRTPU and AIRDEN have been omitted (crossed out) because a default value will be used for these parameters. Input parameters for the evaporation model and canopy penetration model are given on sheets (upper right corner) 1 through 3 of Figure 4-2. Those for the dispersion models are given on pages 4 through 5 and on the extra sheet following sheet 5. This extra sheet is provided for those arrays that exceed the space provided on sheets 1 through 5. For example, there is not enough room to code all of the values for the x axis of the receptor grid system on sheet 4, so the remainder of the x axis values have been coded on the extra sheet shown after sheet 5. Any values coded on this extra sheet that are continuations of values previously shown must be merged back into the input deck in their proper position prior to execution of the program.

4.3 FSCBG EXAMPLE PROBLEM OUTPUT

The FSCBG example problem output is shown in Figure 4-3. Only selected pages of the program output have been included in Figure 4-3 due to the size of the output listing (114 total pages). The first page of Figure 4-3 gives the FSCBG required input data, wake-settling velocity model input data and the evaporation model input data. Note that some parameters have ***** symbols for a value. This means the value was not specified on input and is to be defaulted or calculated by the FSCBG program. The second and third pages of Figure 4-3 show the input data

```
FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                    *** DATE 11/24/80, PAGE   1
                                                          TABLE  1
                                                    - PROGRAM INPUT DATA -
                                            (NOTE - ******* MEANS NOT APPLICABLE)

     *** INPUTS USED BY ALL MODELS ***
PROGRAM OPTIONS, (ISW) = 1 1 2 1 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0
IS LIQUID WATER OR NON-WATER, 2=NON-WATER, 1=WATER, (IFWATR) = 1
AIRCRAFT WING SPAN (WNGSPN (METERS)) =  11.48
WIND SPEED ABOVE CANOPY (WSOCAN (M/S)) = 1.020
HEIGHT OF AIRCRAFT (HGTCFT (METERS)) =  18.10
DENSITY OF SPRAY LIQUID (DENLIQ (G/CM**3)) =   1.0000
AIR TEMPERATURE ABOVE THE CANOPY (AIRTPO (DEG C)) = 14.400
AIR TEMPERATURE BELOW THE CANOPY (AIRTPU (DEG C)) = 14.400
AIR DENSITY (AIRDEN (G/CM**3)) =*********
MOLECULAR WEIGHT OF AIR (AIRMOL) = 28.9644
BAROMETRIC PRESSURE (AIRPRS (MB)) =1013.25
VAPOR PRESS OF EVAPORATING VAPOR AT INFINITY (VAPINF (MB)) =*******
RELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) = 98.900
RELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) = 98.900
     *** INPUTS USED BY THE WAKE SETTLING VELOCITY MODEL ***
AIRCRAFT WEIGHT (ARCRWT (KG)) = 1406.000
AIRCRAFT GROUND SPEED (ARCRSP (M/S)) =  40.200
     *** INPUTS USED BY THE EVAPORATION MODEL ***
UPPER LIMITS OF DROP DIAMETERS (DRPUPR (MICRO-M)) =
1420.000,1020.000, 840.000, 742.000, 667.000, 577.000, 514.000,
 456.000, 351.000, 302.000, 253.000, 200.000, 169.000, 135.000,
 100.000,  51.600,
LOWER LIMITS OF DROP DIAMETERS (DRPLWR (MICRO-M)) =
1020.000, 840.000, 742.000, 667.000, 577.000, 514.000, 456.000,
 351.000, 302.000, 253.000, 200.000, 169.000, 135.000, 100.000,
  51.600,  20.000,
BAROMETRIC PRESSURE (AIRPRS (MB)) =1013.25
MOLECULAR WEIGHT OF AIR (AIRMOL) = 28.9644
MOLECULAR WEIGHT OF EVAPORATING VAPOR (VAPMOL) = 18.0150
RELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) = 98.900
RELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) = 98.900
```

FIGURE 4-3.   FSCBG Example Problem Output Listing.

```
FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                                    *** DATE 11/24/80, PAGE   2
                                                          TABLE  1 (CONT )
                                                     - PROGRAM INPUT DATA -
                                            (NOTE - ******* MEANS NOT APPLICABLE)

     *** INPUTS USED BY THE CANOPY PENETRATION MODEL ***
 WIND SPEED IN BOTTOM QUARTER OF CANOPY (WSIN14 (M/S)) =   .950
 WIND SPEED IN SECOND QUARTER OF CANOPY (WSIN24 (M/S)) =   .840
 WIND SPEED IN THIRD QUARTER OF CANOPY (WSIN34 (M/S)) =   .820
 WIND SPEED IN TOP QUARTER OF CANOPY (WSIN44 (M/S)) =   .900
 HEIGHT OF CANOPY (HGTCAN (METERS)) = 12.00,    .00,    .00,
 PROBABILITY OF PENETRATION (PRBPEN) = .380, .000, .000,
 TREE DENSITY (TREDEN (TREES/ACRE)) =  96.80,     .00,     .00,
 DIAMETER OF VEGETATIVE ELEMENTS (COLEFF (CM)) = 13.00, 13.00, 13.00,
 TREE WIDTH FROM BOTTOM TO TOP FOR FOREST CLASS 1 (TREENV (M)) =
   .210,  .190,  .190, 3.800, 6.600, 6.200, 5.800, 6.400, 5.000,
  4.000, 3.300, 1.600,
```

FIGURE 4-3.   (Continued)

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FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                                          *** DATE 11/24/80, PAGE   3

                                                             TABLE  1 (CONT.)
                                                          - PROGRAM INPUT DATA -
                                                   (NOTE - ******* MEANS NOT APPLICABLE)

     *** INPUTS USED BY THE DISPERSION MODELS ***
 NUMBER OF LINE SOURCES (NSOURC) =   7
 NUMBER OF RECEPTORS IN GRID SYSTEM X AXIS (NXPNTS) =  51
 NUMBER OF RECEPTORS IN GRID SYSTEM Y AXIS (NYPNTS) =   1
 NUMBER OF DISCRETE RECEPTORS (NXYPNT) =   0
 EMISSION OF SPRAY MATERIAL (Q (GRAMS/M)) = .573300+002
 HEIGHT OF DISPERSION MODELS CALCULATION (Z (M)) =     .00
 STANDARD DEV. OF WIND DIRECTION ANGLE (SIGAP (RAD)) = .24609
 STANDARD DEV. OF WIND ELEVATION ANGLE (SIGEP (RAD)) = .20420
 TIME TO SPRAY CLOUD STABILIZATION (TAU (SEC)) =   2.500
 MEASUREMENT TIME FOR SIGAP (TAUO (SEC)) = 600.000
 STAND  DEV. OF SPRAY MATERIAL ALONG SPRAY LINE (SIGXYZ (M)))=   4.000
 DECAY COEFFICIENT (DECAY (/SEC)) = .000000
 LAT., VERT. REFERENCE DISTANCE (XLRZ (M)) =*********
 SURFACE MIXING LAYER HEIGHT (HM (M)) = 1000.000
 WIND DIRECTION (FROM) (THETA (DEG)) =  23.00
 AREA ASSIGNMENT FOR DISCRETE RECEPTORS (DAREA (M**2)) =    10000.00
 RATIO OF LAGRANGIAN TO EULERIAN TIME SCALES (BETA1) =  .00
 WIND-SPEED SHEAR (DELU (M/S)) =  .0000
 X AXIS OF RECEPTOR GRID SYSTEM (X (M)) =     -82.3,    -81.4,
     -80.5,    -79.6,    -78.6,    -77.7,    -76.8,    -75.9,
     -75.0,    -74.1,    -73.2,    -72.2,    -71.3,    -70.4,
     -69.5,    -68.6,    -67.7,    -66.8,    -65.8,    -64.9,
     -64.0,    -63.1,    -62.2,    -61.3,    -60.4,    -59.4,
     -58.5,    -57.6,    -56.7,    -55.8,    -54.9,    -53.9,
     -53.0,    -52.1,    -51.2,    -50.3,    -49.4,    -48.5,
     -47.5,    -46.6,    -45.7,    -44.8,    -43.9,    -43.0,
     -42.1,    -41.1,    -40.2,    -39.3,    -38.4,    -37.5,
     -36.6,
 Y AXIS OF RECEPTOR GRID SYSTEM (Y (M)) =     153.2,
 START AND END X COORDINATES OF LINE SOURCES (DX (M)) =
     -86.9,    -86.9,    -77.7,    -77.7,    -68.6,    -68.6,
     -59.4,    -59.4,    -50.3,    -50.3,    -41.1,    -41.1,
     -32.0,    -32.0,
 START AND END Y COORDINATES OF LINE SOURCES (DY (M)) =
     370.3,   -384.3,    370.3,   -384.3,    370.3,   -384.3,
     370.3,   -384.3,    370.3,   -384.3,    370.3,   -384.3,
     370.3,   -384.3,
 FRACTION OF SPRAY MATERIAL FOR EACH DROP CAT. (PCTMAT) = .01000,
  .02000, .03000, .04000, .10000, .10000, .10000, .20000, .10000,
  .10000, .10000, .04000, .03000, .02000, .00900, .00100,
 SETTLING VEL. SPECIFYING WHICH SET OF GAMA, GAMB AND GAMC TO
 USE (VSGAM (M S)) =  .0400,   .0120
 COEFFICIENTS OF EQUATIONS GIVING SURF. REFLECT. COEFFS. (GAMA,GAMB,GAMC) =
  .750000+000, .834653+000, .916400+000,-.250000+001,-.690314+001,
 -.223571+002, .000000    , .574093+002, .821427+003,
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FIGURE 4-3.   (Continued)

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FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                         *** DATE 11/24/80, PAGE   4

                                                 TABLE  2
                                - ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

     VAPOR PRESSURE OF LIQUID AT INFINITY = .16276310+002 (MB)
     AIR DENSITY = .12200585-002 (G/CM**3)
     MOLAL CONCENTRATION OF AIR-LIQUID MIXTURE = .42122692-004 (G/CM**3)
     DIFFUSIVITY OF EVAPORATING VAPOR INTO AIR AT THE DROP TEMPERATURE = .23294216+000 (CM**2/SEC)
     THERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT THE DROP TEMPERATURE = .53880651-004 (CAL/(SEC.CM.DEGREE K))
     LATENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE = .59086238+003 (CAL/MOLE)
     DROP PRESSURE = .16340134+002 (MB)
     DROP TEMPERATURE = .14290404+002 (DEGREES C)
     WAKE SETTLING VELOCITY = .54999816+000 (M/S)
     ABSOLUTE VISCOSITY (GM/CM/SEC) = .12499794-003
     SCHMIDT NUMBER = .43981910+000
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FIGURE 4-3. (Continued)

FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY *** DATE 11/24/80, PAGE 5

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
18.100	1420.000	1230.992	1020.000	.0000	.0000	.000	.00	4.9376646	100.000
17.798	1419.999	1230.990	1019.998	.3444-008	.3444-008	.061	.06	4.9376601	100.000
17.497	1419.997	1230.989	1019.997	.6850-008	.3406-008	.122	.12	4.9376557	99.999
17.195	1419.996	1230.988	1019.995	.1029-007	.3436-008	.183	.19	4.9376512	99.999
16.893	1419.994	1230.986	1019.994	.1370-007	.3413-008	.244	.25	4.9376467	99.999
16.592	1419.993	1230.985	1019.992	.1714-007	.3436-008	.305	.31	4.9376423	99.998
16.290	1419.992	1230.983	1019.991	.2053-007	.3391-008	.367	.37	4.9376379	99.998
15.988	1419.990	1230.982	1019.989	.2396-007	.3436-008	.428	.44	4.9376335	99.998
15.687	1419.989	1230.980	1019.988	.2741-007	.3444-008	.489	.50	4.9376289	99.997
15.385	1419.987	1230.979	1019.986	.3081-007	.3406-008	.550	.56	4.9376246	99.997
15.083	1419.986	1230.977	1019.985	.3425-007	.3436-008	.611	.62	4.9376200	99.996
14.782	1419.985	1230.976	1019.983	.3767-007	.3421-008	.672	.69	4.9376156	99.996
14.480	1419.983	1230.975	1019.982	.4108-007	.3406-008	.733	.75	4.9376112	99.996
14.178	1419.982	1230.973	1019.980	.4451-007	.3436-008	.794	.81	4.9376068	99.995
13.877	1419.980	1230.972	1019.979	.4793-007	.3413-008	.855	.87	4.9376023	99.995
13.575	1419.979	1230.970	1019.977	.5135-007	.3421-008	.916	.93	4.9375979	99.995
13.273	1419.978	1230.969	1019.976	.5478-007	.3429-008	.978	1.00	4.9375935	99.994
12.972	1419.976	1230.967	1019.974	.5821-007	.3436-008	1.039	1.06	4.9375890	99.994
12.670	1419.975	1230.966	1019.973	.6163-007	.3421-008	1.100	1.12	4.9375845	99.994
12.368	1419.973	1230.965	1019.971	.6506-007	.3429-008	1.161	1.18	4.9375801	99.993
12.067	1419.972	1230.963	1019.970	.6848-007	.3413-008	1.222	1.25	4.9375756	99.993
11.765	1419.971	1230.962	1019.968	.7192-007	.3444-008	1.283	1.31	4.9375711	99.993
11.463	1419.969	1230.960	1019.967	.7533-007	.3406-008	1.344	1.37	4.9375668	99.992
11.162	1419.968	1230.959	1019.965	.7874-007	.3413-008	1.405	1.43	4.9375623	99.992
10.860	1419.966	1230.957	1019.964	.8215-007	.3413-008	1.466	1.50	4.9375578	99.992
10.558	1419.965	1230.956	1019.962	.8560-007	.3444-008	1.527	1.56	4.9375534	99.991
10.257	1419.964	1230.954	1019.961	.8900-007	.3406-008	1.588	1.62	4.9375490	99.991
9.955	1419.962	1230.953	1019.959	.9244-007	.3436-008	1.650	1.68	4.9375445	99.991
9.653	1419.961	1230.952	1019.957	.9588-007	.3444-008	1.711	1.74	4.9375400	99.990
9.352	1419.959	1230.950	1019.956	.9929-007	.3406-008	1.772	1.81	4.9375356	99.990
9.050	1419.958	1230.949	1019.954	.1027-006	.3413-008	1.833	1.87	4.9375312	99.989
8.748	1419.957	1230.947	1019.953	.1061-006	.3436-008	1.894	1.93	4.9375267	99.989
8.447	1419.955	1230.946	1019.951	.1096-006	.3413-008	1.955	1.99	4.9375222	99.989
8.145	1419.954	1230.944	1019.950	.1130-006	.3436-008	2.016	2.06	4.9375178	99.988
7.843	1419.952	1230.943	1019.948	.1164-006	.3413-008	2.077	2.12	4.9375134	99.988
7.542	1419.951	1230.941	1019.947	.1198-006	.3436-008	2.138	2.18	4.9375089	99.988
7.240	1419.950	1230.940	1019.945	.1233-006	.3413-008	2.199	2.24	4.9375045	99.987
6.938	1419.948	1230.939	1019.944	.1267-006	.3413-008	2.261	2.31	4.9375000	99.987
6.637	1419.947	1230.937	1019.942	.1301-006	.3421-008	2.322	2.37	4.9374956	99.987
6.335	1419.945	1230.936	1019.941	.1335-006	.3452-008	2.383	2.43	4.9374911	99.986
6.033	1419.944	1230.934	1019.939	.1369-006	.3391-008	2.444	2.49	4.9374867	99.986
5.732	1419.943	1230.933	1019.938	.1404-006	.3436-008	2.505	2.56	4.9374823	99.986
5.430	1419.941	1230.931	1019.936	.1438-006	.3413-008	2.566	2.62	4.9374778	99.985

FIGURE 4-3. (Continued)

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
5.128	1419.940	1230.930	1019.935	.1472-006	.3436-008	2.627	2.68	4.9374734	99.985
4.827	1419.939	1230.929	1019.933	.1506-006	.3413-008	2.688	2.74	4.9374689	99.985
4.525	1419.937	1230.927	1019.932	.1541-006	.3436-008	2.749	2.80	4.9374645	99.984
4.223	1419.936	1230.926	1019.930	.1575-006	.3413-008	2.810	2.87	4.9374600	99.984
3.922	1419.934	1230.924	1019.929	.1609-006	.3436-008	2.872	2.93	4.9374556	99.984
3.620	1419.933	1230.923	1019.927	.1643-006	.3406-008	2.933	2.99	4.9374511	99.983
3.318	1419.932	1230.921	1019.926	.1678-006	.3444-008	2.994	3.05	4.9374467	99.983
3.017	1419.930	1230.920	1019.924	.1712-006	.3413-008	3.055	3.12	4.9374422	99.982
2.715	1419.929	1230.919	1019.923	.1746-006	.3406-008	3.116	3.18	4.9374378	99.982
2.413	1419.927	1230.917	1019.921	.1780-006	.3444-008	3.177	3.24	4.9374334	99.982
2.112	1419.926	1230.916	1019.920	.1814-006	.3413-008	3.238	3.30	4.9374289	99.981
1.810	1419.925	1230.914	1019.918	.1849-006	.3429-008	3.299	3.37	4.9374244	99.981
1.508	1419.923	1230.913	1019.917	.1883-006	.3436-008	3.360	3.43	4.9374200	99.981
1.207	1419.922	1230.911	1019.915	.1917-006	.3421-008	3.421	3.49	4.9374155	99.980
.905	1419.920	1230.910	1019.913	.1952-006	.3429-008	3.482	3.55	4.9374111	99.980
.603	1419.919	1230.908	1019.912	.1986-006	.3413-008	3.544	3.61	4.9374066	99.980
.302	1419.918	1230.907	1019.910	.2020-006	.3421-008	3.605	3.68	4.9374022	99.979
.000	1419.916	1230.906	1019.909	.2054-006	.3406-008	3.666	3.74	4.9373978	99.979
-.302	1419.915	1230.904	1019.907	.2088-006	.3436-008	3.727	3.80	4.9373933	99.979
-1.098	1419.911	1230.900	1019.903	.2179-006	.1253-007	3.888	3.97	4.9373815	99.978
-2.245	1419.906	1230.895	1019.898	.2310-006	.1804-007	4.120	4.20	4.9373645	99.976
-3.896	1419.898	1230.887	1019.889	.2498-006	.2596-007	4.455	4.54	4.9373401	99.974
-6.274	1419.887	1230.875	1019.877	.2770-006	.3743-007	4.937	5.04	4.9373048	99.972
-9.699	1419.871	1230.859	1019.860	.3161-006	.5390-007	5.630	5.74	4.9372541	99.968
-14.630	1419.848	1230.835	1019.835	.3724-006	.7762-007	6.629	6.76	4.9371809	99.962
-21.730	1419.814	1230.801	1019.799	.4535-006	.1118-006	8.067	8.23	4.9370755	99.954
-31.956	1419.767	1230.752	1019.748	.5703-006	.1611-006	10.138	10.34	4.9369237	99.942
-46.680	1419.698	1230.681	1019.674	.7385-006	.2320-006	13.121	13.38	4.9367052	99.924
-67.882	1419.598	1230.580	1019.567	.9808-006	.3340-006	17.416	17.76	4.9363903	99.900
-98.414	1419.455	1230.433	1019.413	.1330-005	.4809-006	23.601	24.07	4.9359370	99.864
-142.380	1419.249	1230.222	1019.191	.1832-005	.6924-006	32.509	33.16	4.9352840	99.812
-205.691	1418.952	1229.918	1018.871	.2555-005	.9970-006	45.337	46.24	4.9343435	99.738
-296.859	1418.525	1229.479	1018.411	.3596-005	.1435-005	63.815	65.09	4.9329887	99.632
-428.141	1417.909	1228.848	1017.748	.5094-005	.2066-005	90.430	92.24	4.9310368	99.478
-617.187	1417.022	1227.939	1016.793	.7249-005	.2973-005	128.774	131.35	4.9282241	99.258
-889.412	1415.743	1226.628	1015.416	.1035-004	.4277-005	184.023	187.70	4.9241696	98.940
-1281.418	1413.900	1224.738	1013.431	.1481-004	.6150-005	263.655	268.93	4.9183226	98.484
-1845.905	1411.242	1222.013	1010.567	.2122-004	.8839-005	378.476	386.05	4.9098852	97.828
-2880.045	1406.358	1217.006	1005.306	.3291-004	.1170-004	589.267	601.05	4.8943759	96.630
-3905.953	1401.495	1212.019	1000.063	.4447-004	.1155-004	799.042	815.02	4.8789136	95.447
-5429.520	1394.238	1204.576	992.234	.6154-004	.1707-004	1111.811	1134.05	4.8558078	93.700
-6934.923	1387.026	1197.177	984.447	.7830-004	.1676-004	1422.322	1450.77	4.8328068	91.984
-8914.237	1377.478	1187.382	974.130	.1002-003	.2187-004	1832.851	1869.51	4.8023037	89.744

FIGURE 4-3. (Continued)

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	DROP DIAMETER AVERAGE (MICRO-M)	DROP DIAMETER MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	MASS LOST DUE TO EVAPORATION IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
-10378.080	1370.368	1180.087	966.443	.1162-003	.1606-004	2138.154	2180.92	4.7795514	98.100

FIGURE 4-3. (Continued)

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FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                    *** DATE 11/24/80, PAGE   8

                                  TABLE  2 (CONT.)
                       - ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

          - CALCULATED EQUATIONS FOR DROP SIZE CATEGORY  1 (1020.000 - 1420.000 MICRO-M) -

                        SETTLING VELOCITY AS A FUNCTION OF DISTANCE
          VS(MPS) =  .49376656+001 + -.71841217-004 *X+ -.30143473-009 *X**2

                           HEIGHT AS A FUNCTION OF DISTANCE
          H(M) =  .18119107+002 + -.48426686+001 *X+  .34569162-004 *X**2

                FRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HEIGHT
                FRACT =  .99978900+000 +  .11697134-004 *H+  .24207153-010 *H**2

                              TIME AS A FUNCTION OF HEIGHT
          TIME(SEC) =  .36692189+001 + -.20243053+000 *H+  .30951647-006 *H**2

                          DROP DIAMETER AS A FUNCTION OF TIME
     DROP(MICRO-M) =  .12309922+004 + -.23706743-001 *T+ -.47505991-007 *T**2
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FIGURE 4-3.   (Continued)

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FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY                    *** DATE 11/24/80, PAGE  64

                                              TABLE  3
                              - BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

      VAPOR PRESSURE OF LIQUID AT INFINITY = .16276310+002 (MB)
      AIR DENSITY = .12200585-002 (G/CM**3)
      MOLAL CONCENTRATION OF AIR-LIQUID MIXTURE = .42122692-004 (G/CM**3)
      DIFFUSIVITY OF EVAPORATING VAPOR INTO AIR AT THE DROP TEMPERATURE = .23294216+000 (CM**2/SEC)
      THERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT THE DROP TEMPERATURE = .59880651-004 (CAL/(SEC.CM.DEGREE K))
      LATENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE = .59086238+003 (CAL/MOLE)
      DROP PRESSURE = .16340134+002 (MB)
      DROP TEMPERATURE = .14290404+002 (DEGREES C)
      WAKE SETTLING VELOCITY = .54999816+000 (M/S)
      ABSOLUTE VISCOSITY (GM/CM/SEC) = .12499794-003
      SCHMIDT NUMBER = .43981910+000
```

FIGURE 4-3. (Continued)

TABLE 3 (CONT)
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1019.970 - 1419.972 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	DROP DIAMETER AVERAGE (MICRO-M)	DROP DIAMETER MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	MASS LOST DUE TO EVAPORATION IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
12.000	1419.972	1230.963	1019.970	.6848-007	.0000	1.222	1.25	4.9375756	99.993
11.800	1419.971	1230.962	1019.969	.7076-007	.2286-008	1.262	1.28	4.9375727	99.993
11.600	1419.970	1230.961	1019.968	.7305-007	.2286-008	1.303	1.32	4.9375696	99.993
11.400	1419.969	1230.960	1019.967	.7533-007	.2278-008	1.343	1.36	4.9375667	99.992
11.200	1419.968	1230.959	1019.966	.7761-007	.2286-008	1.384	1.39	4.9375637	99.992
11.000	1419.967	1230.958	1019.965	.7987-007	.2263-008	1.424	1.43	4.9375607	99.992
10.800	1419.966	1230.957	1019.964	.8215-007	.2278-008	1.465	1.47	4.9375578	99.992
10.600	1419.965	1230.956	1019.963	.8441-007	.2263-008	1.505	1.50	4.9375549	99.991
10.400	1419.965	1230.955	1019.962	.8669-007	.2278-008	1.546	1.54	4.9375520	99.991
10.200	1419.964	1230.954	1019.961	.8898-007	.2286-008	1.586	1.57	4.9375490	99.991
10.000	1419.963	1230.954	1019.960	.9124-007	.2263-008	1.627	1.61	4.9375460	99.991
9.800	1419.962	1230.953	1019.959	.9353-007	.2286-008	1.667	1.65	4.9375430	99.990
9.600	1419.961	1230.952	1019.958	.9579-007	.2263-008	1.708	1.68	4.9375402	99.990
9.400	1419.960	1230.951	1019.957	.9808-007	.2286-008	1.748	1.72	4.9375371	99.990
9.200	1419.959	1230.950	1019.956	.1003-006	.2271-008	1.789	1.76	4.9375342	99.990
9.000	1419.958	1230.949	1019.955	.1026-006	.2263-008	1.829	1.79	4.9375312	99.989
8.800	1419.957	1230.948	1019.954	.1049-006	.2286-008	1.870	1.83	4.9375283	99.989
8.600	1419.956	1230.947	1019.953	.1072-006	.2286-008	1.911	1.86	4.9375253	99.989
8.400	1419.955	1230.946	1019.952	.1094-006	.2263-008	1.951	1.89	4.9375224	99.989
8.200	1419.954	1230.945	1019.951	.1117-006	.2278-008	1.992	1.93	4.9375194	99.989
8.000	1419.953	1230.944	1019.950	.1140-006	.2286-008	2.032	1.96	4.9375165	99.988
7.800	1419.952	1230.943	1019.949	.1163-006	.2278-008	2.073	1.99	4.9375135	99.988
7.600	1419.952	1230.942	1019.947	.1185-006	.2263-008	2.113	2.03	4.9375106	99.988
7.400	1419.951	1230.941	1019.946	.1208-006	.2263-008	2.154	2.06	4.9375076	99.988
7.200	1419.950	1230.940	1019.945	.1231-006	.2286-008	2.194	2.09	4.9375046	99.987
7.000	1419.949	1230.939	1019.944	.1254-006	.2278-008	2.235	2.13	4.9375017	99.987
6.800	1419.948	1230.938	1019.943	.1276-006	.2263-008	2.275	2.16	4.9374987	99.987
6.600	1419.947	1230.937	1019.942	.1299-006	.2286-008	2.316	2.19	4.9374958	99.987
6.400	1419.946	1230.936	1019.941	.1322-006	.2286-008	2.356	2.22	4.9374928	99.986
6.200	1419.945	1230.935	1019.940	.1345-006	.2278-008	2.397	2.26	4.9374899	99.986
6.000	1419.944	1230.934	1019.939	.1367-006	.2255-008	2.437	2.29	4.9374869	99.986
5.800	1419.943	1230.933	1019.938	.1390-006	.2286-008	2.478	2.33	4.9374840	99.986
5.600	1419.942	1230.932	1019.937	.1413-006	.2286-008	2.518	2.36	4.9374810	99.986
5.400	1419.941	1230.932	1019.936	.1436-006	.2263-008	2.559	2.39	4.9374791	99.985
5.200	1419.940	1230.931	1019.935	.1459-006	.2286-008	2.599	2.43	4.9374751	99.985
5.000	1419.939	1230.930	1019.934	.1481-006	.2278-008	2.640	2.46	4.9374721	99.985
4.800	1419.938	1230.929	1019.933	.1504-006	.2263-008	2.680	2.50	4.9374692	99.985
4.600	1419.938	1230.928	1019.932	.1527-006	.2278-008	2.721	2.53	4.9374663	99.984
4.400	1419.937	1230.927	1019.931	.1550-006	.2286-008	2.761	2.56	4.9374633	99.984
4.200	1419.936	1230.926	1019.930	.1573-006	.2286-008	2.802	2.60	4.9374603	99.984
4.000	1419.935	1230.925	1019.929	.1595-006	.2255-008	2.842	2.63	4.9374574	99.984
3.800	1419.934	1230.924	1019.928	.1618-006	.2286-008	2.883	2.67	4.9374544	99.983
3.600	1419.933	1230.923	1019.927	.1641-006	.2263-008	2.923	2.70	4.9374514	99.983

FIGURE 4-3. (Continued)

TABLE 3 (CONT.)
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1019.970 - 1419.972 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	DROP DIAMETER AVERAGE (MICRO-M)	DROP DIAMETER MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	MASS LOST DUE TO EVAPORATION IN DM (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
3.400	1419.932	1230.922	1019.926	.1663-006	.2286-008	2.964	2.73	4.9374485	99.983
3.200	1419.931	1230.921	1019.925	.1686-006	.2255-008	3.004	2.77	4.9374455	99.983
3.000	1419.930	1230.920	1019.924	.1709-006	.2278-008	3.045	2.80	4.9374425	99.982
2.800	1419.929	1230.919	1019.923	.1732-006	.2286-008	3.085	2.84	4.9374396	99.982
2.600	1419.928	1230.918	1019.922	.1755-006	.2286-008	3.126	2.88	4.9374366	99.982
2.400	1419.927	1230.917	1019.921	.1777-006	.2263-008	3.166	2.92	4.9374337	99.982
2.200	1419.926	1230.916	1019.920	.1800-006	.2286-008	3.207	2.96	4.9374307	99.982
2.000	1419.925	1230.915	1019.919	.1823-006	.2255-008	3.247	2.99	4.9374278	99.981
1.800	1419.925	1230.914	1019.918	.1845-006	.2286-008	3.288	3.03	4.9374248	99.981
1.600	1419.924	1230.913	1019.917	.1868-006	.2278-008	3.328	3.07	4.9374219	99.981
1.400	1419.923	1230.912	1019.916	.1891-006	.2263-008	3.369	3.11	4.9374190	99.981
1.200	1419.922	1230.911	1019.915	.1914-006	.2286-008	3.409	3.15	4.9374160	99.980
1.000	1419.921	1230.910	1019.914	.1936-006	.2278-008	3.450	3.19	4.9374130	99.980
.800	1419.920	1230.910	1019.913	.1959-006	.2286-008	3.490	3.23	4.9374101	99.980
.600	1419.919	1230.909	1019.912	.1982-006	.2263-008	3.531	3.26	4.9374072	99.980
.400	1419.918	1230.908	1019.911	.2005-006	.2286-008	3.571	3.30	4.9374042	99.979
.200	1419.917	1230.907	1019.910	.2028-006	.2278-008	3.612	3.34	4.9374012	99.979
.000	1419.916	1230.906	1019.909	.2050-006	.2255-008	3.652	3.38	4.9373983	99.979
-.200	1419.915	1230.905	1019.908	.2073-006	.2286-008	3.693	3.42	4.9373953	99.979

FIGURE 4-3. (Continued)

```
                         TABLE  3 (CONT.)
           - BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

  - CALCULATED EQUATIONS FOR DROP SIZE CATEGORY  1 (1019.970 - 1419.972 MICRO-M) -

                 SETTLING VELOCITY AS A FUNCTION OF HEIGHT
     VS(MPS) =   .49373983+001 +   .14773079-004 *H+   .11027818-009 *H**2

                   HEIGHT AS A FUNCTION OF DISTANCE
       H(M) =  .11926300+002 + -.59956063+001 *X+   .12372368+000 *X**2

                   DISTANCE AS A FUNCTION OF HEIGHT
      X(M) =  .20776707+001 + -.18199798+000 *H+   .65906207-003 *H**2

      FRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HEIGHT
      FRACT =  .99986259+000 +  .11651691-004 *H+ -.14707752-009 *H**2

                  DROP DIAMETER AS A FUNCTION OF HEIGHT
  DROP(MICRON) =   .12309057+004 +   .47817502-002 *H+ -.10877131-006 *H**2

                   DROP DIAMETER AS A FUNCTION OF TIME
  DROP(MICRON) =  .12309919+004 + -.23591295-001 *T+ -.24819962-005 *T**2
```

FIGURE 4-3.   (Continued)

TABLE 4
- CALCULATED VALUES FROM CANOPY PENETRATION MODEL -

DROP SIZE CATEGORY	HGT= 12.0 M FRACT	HGT= 12.0 M DIST(M)	HGT= 10.8 M FRACT	HGT= 10.8 M DIST(M)	HGT= 9.6 M FRACT	HGT= 9.6 M DIST(M)	HGT= 8.4 M FRACT	HGT= 8.4 M DIST(M)	HGT= 7.2 M FRACT	HGT= 7.2 M DIST(M)	HGT= 6.0 M FRACT	HGT= 6.0 M DIST(M)
1	1.00000	.0	.69800	.2	.62600	.4	.52400	.6	.37200	.8	.37200	1.0
2	1.00000	.0	.72000	.2	.66800	.5	.57400	.8	.43600	1.0	.43600	1.3
3	1.00000	.0	.74400	.3	.69600	.6	.61200	.9	.44400	1.2	.44400	1.5
4	1.00000	.0	.73200	.3	.68400	.6	.60800	1.0	.47600	1.3	.47600	1.6
5	1.00000	.0	.67800	.4	.61400	.7	.54600	1.1	.41800	1.5	.41800	1.8
6	1.00000	.0	.80600	.4	.73400	.8	.64200	1.3	.51800	1.7	.51200	2.1
7	1.00000	.0	.81400	.5	.74600	1.0	.64400	1.4	.51400	1.9	.51200	2.4
8	1.00000	.0	.84200	.6	.79000	1.1	.67600	1.7	.51400	2.3	.47800	2.9
9	1.00000	.0	.88800	.7	.82000	1.4	.73400	2.1	.62200	2.8	.53400	3.5
10	1.00000	.0	.93200	.8	.86600	1.7	.78800	2.5	.67200	3.3	.55000	4.2
11	1.00000	.0	1.00000	1.1	.94000	2.1	.81400	3.2	.68600	4.3	.57800	5.5
12	1.00000	.0	.87800	1.3	.79000	2.7	.69200	4.0	.59400	5.4	.50400	6.8
13	1.00000	.0	.99200	1.7	.91200	3.4	.79400	5.1	.69600	6.8	.61000	8.5
14	1.00000	.0	.92200	2.5	.85000	5.0	.77200	7.5	.68400	10.0	.63000	12.6
15	1.00000	.0	.97200	4.7	.91800	9.4	.84800	14.2	.80000	19.2	.73600	24.1
16	1.00000	.0	.26000	64.2	.00000	220.4	.00000	468.6	.00000	808.8	.00000	1241.0

DROP SIZE CATEGORY	HGT= 4.8 M FRACT	HGT= 4.8 M DIST(M)	HGT= 3.6 M FRACT	HGT= 3.6 M DIST(M)	HGT= 2.4 M FRACT	HGT= 2.4 M DIST(M)	HGT= 1.2 M FRACT	HGT= 1.2 M DIST(M)	HGT= .0 M FRACT	HGT= .0 M DIST(M)
1	.30600	1.2	.30600	1.4	.30600	1.7	.30600	1.9	.30600	2.1
2	.34800	1.5	.34800	1.8	.34800	2.1	.34800	2.3	.34800	2.6
3	.33800	1.8	.33800	2.1	.33800	2.4	.33800	2.7	.33800	3.0
4	.35400	2.0	.35400	2.3	.35400	2.6	.35400	3.0	.35400	3.3
5	.33000	2.2	.33000	2.6	.33000	3.0	.33000	3.4	.33000	3.8
6	.38800	2.6	.38800	3.0	.38800	3.5	.38800	3.9	.38800	4.4
7	.41000	2.9	.41000	3.4	.41000	3.9	.41000	4.5	.41000	5.0
8	.36800	3.5	.36800	4.1	.36800	4.7	.36800	5.3	.36800	5.9
9	.37400	4.2	.37400	4.9	.37400	5.7	.37400	6.4	.37400	7.2
10	.36800	5.1	.33000	5.9	.33000	6.8	.33000	7.7	.33000	8.6
11	.41400	6.6	.32400	7.7	.30800	8.9	.30800	10.0	.30800	11.2
12	.38600	8.2	.32400	9.6	.31000	11.0	.31000	12.5	.30800	13.9
13	.56200	10.3	.52400	12.1	.51800	13.9	.51800	15.7	.51800	17.5
14	.56600	15.2	.53800	17.8	.52800	20.5	.52800	23.2	.52800	25.9
15	.71000	29.2	.68000	34.3	.67600	39.5	.67600	44.8	.67600	50.2
16	.00000	1765.3	.00000	2381.6	.00000	3090.0	.00000	3890.3	.00000	4782.7

FIGURE 4-3. (Continued)

TABLE 5

- DEPOSITION (DROPS /SQUARE METER) *-*
- AT A HEIGHT OF .0000 METERS *-*
(MAXIMUM DEPOSITION = .2189868+006 AT X= -75.000, Y= 153.200)

Y AXIS (METERS)	- X AXIS (METERS) - - DEPOSITION -								
	-82.30	-81.40	-80.50	-79.60	-78.60	-77.70	-76.80	-75.90	-75.00
153.20	.206238+006	.202115+006	.203213+006	.205261+006	.206019+006	.207985+006	.213043+006	.218663+006	218987+006

Y AXIS (METERS)	- X AXIS (METERS) - - DEPOSITION -								
	-74.10	-73.20	-72.20	-71.30	-70.40	-69.50	-68.60	-67.70	-66.80
153.20	.212073+006	.203174+006	.198979+006	.200708+006	.203121+006	.204133+006	.206073+006	.211251+006	.217335+006

Y AXIS (METERS)	- X AXIS (METERS) - - DEPOSITION -								
	-65.80	-64.90	-64.00	-63.10	-62.20	-61.30	-60.40	-59.40	-58.50
153.20	.218262+006	.211396+006	.202440+006	.198056+006	.198865+006	.200595+006	.200937+006	.202431+006	.207150+005

Y AXIS (METERS)	- X AXIS (METERS) - - DEPOSITION -								
	-57.60	-56.70	-55.80	-54.90	-53.90	-53.00	-52.10	-51.20	-50.30
153.20	.212278+006	.212052+006	.204519+006	.194920+006	.189837+006	.190550+006	.192015+006	.191822+006	.192370+006

Y AXIS (METERS)	- X AXIS (METERS) - - DEPOSITION -								
	-49.40	-48.50	-47.50	-46.60	-45.70	-44.80	-43.90	-43.00	-42.10
153.20	195935+006	200136+006	.198588+006	.189073+006	.176977+006	.168953+006	.165190+006	.161549+006	155426+006

FIGURE 4-3. (Continued)

FOREST SPRAY MODEL *** FSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY *** DATE 11/24/80, PAGE 115

TABLE 5 (CONT.)

- DEPOSITION (DROPS /SQUARE METER) *-*
- AT A HEIGHT OF .0000 METERS *-*
(MAXIMUM DEPOSITION = .2189868+006 AT X= -75.000, Y= 153.200)

Y AXIS (METERS)	- X AXIS (METERS) - -41.10	-40.20	-39.30	-38.40	-37.50	-36.60
	- DEPOSITION -					
153.20	.148175+006	.143339+006	.137056+006	.123364+006	.100274+006	.733324+005

FIGURE 4-3. (Continued)

used by the canopy penetration model and dispersion models, respectively. The ***** symbols are also used on these pages to show parameters that are to be calculated by the program. Pages 4 through 111 are printed only if the parameter ISW(5) is set non-zero. In this example, only pages 4 through 7 and 63 through 66 (upper right corner) are shown. Page 4 gives calculated parameters used by the evaporation model. Pages 5 through 7 show the above canopy evaporation calculations for drop-size category 1. A set of pages similar to pages 5 through 7 are printed for each drop size category for above canopy evaporation. The program prints the height, the maximum, mean and minimum drop diameter, the total mass lost to evaporation, the mass lost to evaporation in the height interval, the fall time, the horizontal travel distance, the settling velocity and the percent of spray material reaching the given height as drops. This information is printed down the page until the minimum drop diameter of 2 micrometers is achieved, or the drop is essentially evaporated or until the height falls to -10000 meters. The evaporation is calculated until these criteria are met because the FSCBG program requires the complete curve of evaporation in order to calculate the equations of height versus distance, drop size versus distance, etc. above the canopy. The last page for each drop size category (page 7) details the equations required by the canopy penetration model and dispersion models. Pages 63 through 66 (upper right corner) are the same in content as pages 5 through 7, except these pages give the evaporation detail below the canopy for drop-size category 1. The below-canopy evaporation calculations are stopped at the ground and are not made for negative heights as in the case for the above-canopy evaporation calculations. Page 112 (upper right corner) of Figure 4-3 shows the output from the canopy penetration model and is obtained by the ISW(3) option. For each drop-size category, the FSCBG program prints the fraction of drops reaching each 10th of the forest canopy height. The fraction of drop material printed here accounts for losses due to evaporation and losses due to impaction in the upper areas of the canopy. Note that drop size category 16 only reaches the 10.8 meter level. This

is because the drop evaporates before it can penetrate any deeper into the canopy. Also, the horizontal travel distance required for drops in each category to reach each 10th of the forest canopy height is printed. Pages 113 and 114 (upper right corner) of Figure 4-3 show the ground level deposition calculated for this example problem. The output displays "DEPOSITION", the output units, the maximum calculated value and location followed by the deposition at each input receptor point. A listing of dosage or concentration would appear in the same format.

The FSCBG program has also been used to calculate deposition occurring along the sampling line shown in Figure 4-1 for relative humidities of 70 and 50 percent, with all other model inputs described in Section 4.1 remaining the same. The results of the ground-level deposition for all three humidity values are shown in Figure 4-4.

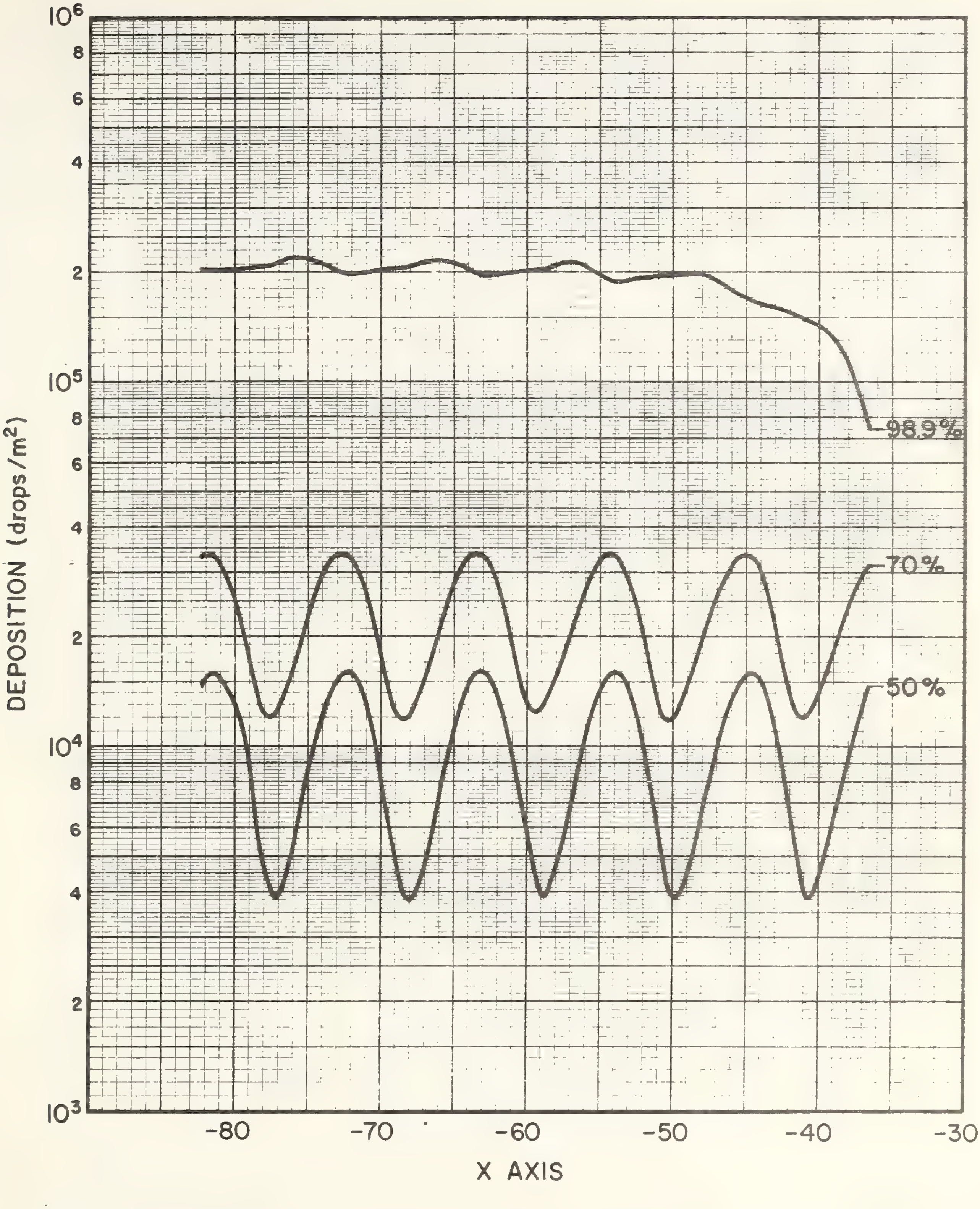

FIGURE 4-4. Results of the example deposition calculation for relative humidities of 98.9, 70 and 50 percent.

SECTION 5
FSCBG PROGRAM LISTING

This section gives a complete FORTRAN listing of the FSCBG computer program and all subroutines,

```
C     VERSION 1, SEPT 1980, BJORKLUND, H. E. CRAMER CO. INC.              S0100010
C                                                                         S0100020
C                                                                         S0100030
C     THIS PROGRAM IS DESIGNED TO CALCULATE DOSAGE AND CONCENTRATION     S0100040
C     ABOVE A FOREST CANOPY AND DEPOSITION ABOVE OR BELOW A FOREST        S0100050
C     CANOPY DOWNWIND OF MULTIPLE LINE SOURCES DEFINED BY AIRCRAFT        S0100060
C     SPRAY LINES. ALSO, THIS PROGRAM HAS THE CAPABILITY OF ACCOUNTING    S0100070
C     FOR LOSS OF SPRAY MATERIAL DUE TO EVAPORATION AND THE LOSS OF       S0100080
C     MATERIAL DUE TO IMPACTION WITHIN THE FOREST CANOPY, WHERE FOREST    S0100090
C     CANOPY IS DEFINED TO BE ANY ABOVE GROUND VEGETATION.               S0100100
C                                                                         S0100110
C                                                                         S0100120
C                                                                         S0100130
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40),  S0100140
     *ISW(20),I,J,K,L,M,N,NVS                                             S0100150
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),                 S0100160
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,    S0100170
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),    S0100180
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),    S0100190
     *CHID(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSB(20),A13(20),    S0100200
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1       S0100210
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DFLU,CONV(20)              S0100220
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,     S0100230
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,           S0100240
     *AIRTPU,AIRMOL,DENLIQ,RFLHMO,RELHMU,DRPUPR(20),DRPLWR(20),          S0100250
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPFN(3),COLEFF(20),TRFDEN(3),        S0100260
     *TRFENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),       S0100270
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,        S0100280
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,     S0100290
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),     S0100300
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMD(20),       S0100310
     *TMLSO(20),RDST(20),XLOCS(20),                                      S0100320
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),   S0100330
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                        S0100340
      INTEGER TITLE                                                       S0100350
C                                                                         S0100360
C                                                                         S0100370
C                                                                         S0100380
```

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C****************- FSCBG REQUIRED INPUT DATA -***- DEFAULT VALUES ARE    S0100390
C         PROVIDED ONLY IF THE RESPECTIVE INPUT PARAMETER IS OMITTED    S0100400
C         FROM THE INPUT DATA.                                          S0100410
C                                                                       S0100420
C      TITLE - CASE TITLING INFORMATION. A MAXIMUM OF 80 CHARACTERS MAY S0100430
C              BE INPUT. IF NOT INPUT THE TITLE IS DEFAULTED TO BLANKS. S0100440
C                                                                       S0100450
C      ISW - FSCBG PROGRAM OPTION ARRAY.                                S0100460
C         ISW(1) - WAKE SETTLING VELOCITY OPTION.                       S0100470
C                   IF = 0, THE PROGRAM ASSUMES THE WAKE SETTLING       S0100480
C                           VELOCITY WAKVEL IS BEING INPUT.             S0100490
C                   IF = 1, THE PROGRAM ASSUMES THE WAKE SETTLING       S0100500
C                           VELOCITY IS TO BE CALCULATED FROM THE INPUT S0100510
C                           PARAMETERS - ARCRWT, AIRDEN, WNGSPN AND     S0100520
C                           ARCRSP.                                     S0100530
C         ISW(2) - EVAPORATION MODEL OPTION.                            S0100540
C                   IF = 0, THE EVAPORATION MODEL IS NOT EXECUTED. THE  S0100550
C                           PROGRAM ASSUMES THERE IS NO CHANGE IN DROP  S0100560
C                           SIZE WITH TIME.                             S0100570
C                   IF = 1, THE EVAPORATION MODEL IS EXECUTED. THE      S0100580
C                           PROGRAM CALCULATES THE RATE OF CHANGE OF    S0100590
C                           DROP SIZE WITH TIME FOR BOTH ABOVE AND BELOW S0100600
C                           THE CANOPY.                                 S0100610
C                   IF = 2, THE EVAPORATION MODEL IS NOT EXECUTED. THE  S0100620
C                           PROGRAM ASSUMES THE USER INPUTS THE EQUATIONSS0100630
C                           OF THE RATE OF CHANGE OF DROP SIZE WITH TIME S0100640
C                           FOR BOTH ABOVE AND BELOW THE CANOPY.        S0100650
C         ISW(3) - CANOPY PENETRATION MODEL OPTION.                     S0100660
C                   IF = 0, THE CANOPY PENETRATION MODEL IS NOT EXECUTED.S0100670
C                   IF = 1, THE CANOPY PENETRATION MODEL IS EXECUTED.   S0100680
C                           THE PROGRAM CALCULATES THE PERCENTAGE OF THE S0100690
C                           RELEASED MATERIAL THAT REACHES THE 10THS OF S0100700
C                           THE FOREST CANOPY HEIGHT FOR EACH DROP SIZE S0100710
C                           CATEGORY.                                   S0100720
C                   IF = 2, THE SAME AS 1, PLUS CANOPY PENETRATION MODEL S0100730
C                           CALCULATIONS ARE PRINTED.                   S0100740
C                   IF = 3, THE SAME AS 2, PLUS DEBUG CALCULATIONS ARE  S0100750
C                           PRINTED. ONLY USE ONE DROP SIZE CATEGORY DUE S0100760
```

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C                   TO THE LARGE VOLUME OF PRINT OUTPUT.          S0100770
C         ISW(4) - DISPERSION MODELS OPTION.                        S0100780
C                  IF = 0, THE DISPERSION MODELS ARE NOT EXECUTED.  S0100790
C                  IF = 1, THE DISPERSION MODELS ARE EXECUTED, PRODUCINGS0100800
C                          DOSAGE, CONCENTRATION AND/OR DEPOSITION   S0100810
C                          DEPENDING ON ISW(6), ISW(7) AND/OR ISW(8), S0100820
C                          RESPECTIVELY.                             S0100830
C                  IF = 2, THE SAME AS 1, PLUS DEBUG CALCULATIONS ARE S0100840
C                          PRINTED. ONLY USE ONE DROP SIZE CATEGORY, S0100850
C                          FEW SOURCES AND FEW RECEPTORS DUE TO THE  S0100860
C                          LARGE VOLUME OF PRINT OUTPUT.             S0100870
C         ISW(5) - PRINT EVAPORATION MODEL (ISW(2)) CALCULATIONS OPTION.S0100880
C                  IF = 0, EVAPORATION MODEL CALCULATIONS ARE NOT    S0100890
C                          PRINTED. THIS INCLUDES ALL CALCULATIONS UNDERS0100900
C                          ISW(2).                                   S0100910
C                  IF = 1, THE EVAPORATION MODEL CALCULATIONS ARE    S0100920
C                          PRINTED. THIS INCLUDES ALL CALCULATIONS UNDERS0100930
C                          ISW(2).                                   S0100940
C                  IF = 2, THE SAME AS 1, PLUS DEBUG CALCULATIONS ARE S0100950
C                          PRINTED. ONLY USE A FEW DROP SIZE CATEGORIES S0100960
C                          DUE TO THE LARGE VOLUME OF PRINT OUTPUT.  S0100970
C         ISW(6) - DOSAGE MODEL OPTION.                             S0100980
C                  IF = 0, THE DOSAGE IS NOT CALCULATED.            S0100990
C                  IF = 1, THE DOSAGE IS CALCULATED AND PRINTED. NOTE S0101000
C                          THAT DOSAGE CAN ONLY BE CALCULATED AT HEIGHT S0101010
C                          Z GREATER THAN OR EQUAL TO THE HEIGHT OF THE S0101020
C                          CANOPY HGTCAN AND LESS THAN THE HEIGHT OF THES0101030
C                          AIRCRAFT.                                 S0101040
C         ISW(7) - CONCENTRATION MODEL OPTION.                      S0101050
C                  IF = 0, THE CONCENTRATION IS NOT CALCULATED.     S0101060
C                  IF = 1, THE CONCENTRATION IS CALCULATED AND PRINTED. S0101070
C                          NOTE THAT CONCENTRATION CAN ONLY BE       S0101080
C                          CALCULATED AT HEIGHT Z GREATER THAN OR EQUAL S0101090
C                          TO THE HEIGHT OF THE CANOPY HGTCAN AND LESS S0101100
C                          THAN THE HEIGHT OF THE AIRCRAFT.          S0101110
C         ISW(8) - DEPOSITION MODEL OPTION.                         S0101120
C                  IF = 0, THE DEPOSITION IS NOT CALCULATED.        S0101130
C                  IF = 1, THE DEPOSITION IS CALCULATED AND PRINTED. S0101140
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C                   DEPOSITION CAN BE CALCULATED AT ANY HEIGHT Z S0101150
C                   LESS THAN THE HEIGHT OF THE AIRCRAFT HGTCFT  S0101160
C                   AND GREATER THAN OR EQUAL TO 0 (GROUND).     S0101170
C     ISW(9) - DOSAGE, CONCENTRATION, DEPOSITION OUTPUT UNITS    S0101180
C              CONVERSION OPTION. THIS OPTION ASSUMES THAT THE   S0101190
C              EMISSION RATE Q IS INPUT IN GRAMS/METER IF SWATH  S0101200
C              IS INPUT AS 0. OTHERWISE Q IS ASSUMED TO BE IN    S0101210
C              GALLONS/ACRE WHEN SWATH IS INPUT NON-ZERO.        S0101220
C              ALL UNITS CONVERSION IS HANDLED AUTOMATICALLY BY THE S0101230
C              PROGRAM.                                          S0101240
C              IF = 0, PRINT UNITS ARE DROPS. (VAPOR DOSAGE AND  S0101250
C                   CONCENTRATION ARE NOT INCLUDED IN THE        S0101260
C                   CALCULATION WHEN ISW(9) = 0)                 S0101270
C              IF = 1, PRINT UNITS ARE MICROGRAMS.               S0101280
C              IF = 2, PRINT UNITS ARE MILLIGRAMS.               S0101290
C              IF = 3, PRINT UNITS ARE GRAMS.                    S0101300
C              IF = 4, PRINT UNITS ARE OUNCES.                   S0101310
C              IF = 5, PRINT UNITS ARE POUNDS.                   S0101320
C     ISW(10)- DOSAGE PRINT TIME UNITS OPTION. THE PROGRAM ASSUMES  S0101330
C              ALL INPUT TIME UNITS ARE SECONDS.                 S0101340
C              IF = 0, PRINT UNITS ARE SECONDS (GRAM SECONDS/M**3). S0101350
C              IF = 1, PRINT UNITS ARE MINUTES (GRAM MINUTES/M**3). S0101360
C     ISW(11)- DOSAGE, CONCENTRATION, DEPOSITION PRINT VOLUME OR    S0101370
C              AREA LENGTH UNITS OPTION.                         S0101380
C                   DOSAGE CONCENTRATION DEPOSITION AREA-COVERAGES0101390
C              IF = 0,  M**3       M**3        M**2        M**2    S0101400
C              IF = 1, FT**3      FT**3       FT**2       FT**2    S0101410
C              IF = 2,  M**3       M**3        ACRE        ACRE    S0101420
C              IF = 3, FT**3      FT**3        ACRE        ACRE    S0101430
C              IF = 4,  M**3       M**3     HECTARES    HECTARES   S0101440
C     ISW(12)- AREA OF COVERAGE OPTION.                          S0101450
C              IF = 0, AREA OF COVERAGE IS NOT CALCULATED.       S0101460
C              IF = 1, AREA OF COVERAGE OF DOSAGE, CONCENTRATION S0101470
C                   AND/OR DEPOSITION IS CALCULATED DEPENDING ON S0101480
C                   DOSLV, CONLV AND/OR DEPLV, RESPECTIVELY.     S0101490
C                   THE AREA OF COVERAGE IS THAT TOTAL AREA OR   S0101500
C                   AREAS COVERED BY THE GIVEN LEVELS OF DOSAGE, S0101510
C                   CONCENTRATION AND/OR DEPOSITION IN DOSLV,    S0101520
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C                       CONLV AND/OR DEPLV.                              S0101530
C           ISW(13)-ISW(20)- RESERVED FOR FUTURE OPTIONS.                S0101540
C                                                                        S0101550
C       IFWATR - SWITCH USED TO INFORM THE PROGRAM OF WHETHER WATER OR A  S0101560
C                NON-WATER BASE LIQUID IS TO BE MODELED (DEFAULT=1).      S0101570
C                IF = 2, THE PROGRAM ASSUMES THE DROPS ARE NON-WATER BASE.S0101580
C                IF = 1, THE PROGRAM ASSUMES THE DROPS ARE WATER BASE.    S0101590
C                                                                        S0101600
C       WNGSPN - AIRCRAFT WING SPAN OR HELICOPTER ROTOR DIAMETER IN METERSS0101610
C                (NO DEFAULT).                                            S0101620
C                                                                        S0101630
C       WSOCAN - WIND SPEED IN METERS/SEC ABOVE THE CANOPY (NO DEFAULT).  S0101640
C                                                                        S0101650
C       HGTCFT - HEIGHT ABOVE THE GROUND OF THE AIRCRAFT IN METERS (NO    S0101660
C                DEFAULT).                                                S0101670
C                                                                        S0101680
C       DENLIQ - DENSITY OF THE DROP LIQUID IN GRAMS/CM**3 (DEFAULT=1.0)  S0101690
C                                                                        S0101700
C       AIRTPO - AIR TEMPERATURE IN DEGREES CELCIUS ABOVE THE CANOPY (NO  S0101710
C                DEFAULT).                                                S0101720
C                                                                        S0101730
C       AIRTPU - AIR TEMPERATURE IN DEGREES CELCIUS BELOW THE CANOPY      S0101740
C                (DEFAULT=AIRTPO).                                        S0101750
C                                                                        S0101760
C       AIRDEN - AIR DENSITY IN GRAMS/CM**3. IF NOT INPUT THEN YOU MUST   S0101770
C                INPUT AIRMOL, AIRPRS AND VAPINF. IF VAPINF IS NOT INPUT  S0101780
C                OR IFWATR EQUALS 1 THEN YOU MUST INPUT RELHMO AND RELHMU S0101790
C                RATHER THAN VAPINF. THESE PARAMETERS ARE DEFINED BELOW.  S0101800
C                                                                        S0101810
C***************- INPUTS DEPENDING ON ISW(1)                              S0101820
C                                                                        S0101830
C-IF ISW(1) = 0                                                          S0101840
C                                                                        S0101850
C       WAKVEL - WAKE SETTLING VELOCITY IN METERS/SEC (NO DEFAULT).       S0101860
C                                                                        S0101870
C-IF ISW(1) = 1                                                          S0101880
C                                                                        S0101890
C       ARCRWT - AIRCRAFT WEIGHT IN KILOGRAMS (NO DEFAULT).               S0101900
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C
C     ARCRSP - AIRCRAFT GROUND SPEED IN METERS/SEC (NO DEFAULT).
C
C****************- INPUTS DEPENDING ON ISW(2)
C
C-IF ISW(2) = 0 OR 1
C
C     DRPUPR - ARRAY CONTAINING THE INITIAL UPPER LIMITS TO THE DROP
C              DIAMETER IN MICROMETERS OF EACH DROP SIZE CATEGORY. THERE
C              ARE A MAXIMUM OF 20 DROP SIZE CATEGORIES. VALUES INPUT
C              TO DRPUPR MUST BE IN DESCENDING ORDER OF SIZE. THE
C              NUMBER OF DROP SIZE CATEGORIES IS DETERMINED BY THE
C              NUMBER OF NON-ZERO VALUES INPUT (NO DEFAULTS). IF ISW(2)
C              EQUALS 0, THIS ARRAY MAY BE THE GEOMETRIC MEAN DIAMETER
C              IN MICROMETERS AS LONG AS THE ARRAY DRPLWR IS OMITTED OR
C              SET EQUAL TO THE SAME SET OF VALUES AS DRPUPR.
C
C     DRPLWR - ARRAY CONTAINING THE INITIAL LOWER LIMITS TO THE DROP
C              DIAMETER IN MICROMETERS OF EACH DROP SIZE CATEGORY. THERE
C              ARE A MAXIMUM OF 20 DROP SIZE CATEGORIES. VALUES INPUT
C              TO DRPLWR MUST BE IN DESCENDING ORDER OF SIZE (DEFAULT =
C              DRPUPR).
C
C-IF ISW(2) = 1
C
C     AIRPRS - BAROMETRIC PRESSURE IN MILLIBARS (DEFAULT=1013.25)
C              (ACTUAL, NOT REDUCED TO SEA LEVEL)
C
C     AIRMOL - MOLECULAR WEIGHT OF AIR (DEFAULT=28.9644).
C
C     VAPMOL - MOLECULAR WEIGHT OF THE EVAPORATING VAPOR
C              (DEFAULT=18.015).
C
C     RELHMO - RELATIVE HUMIDITY IN PERCENT ABOVE THE CANOPY (NO
C              DEFAULT).
C
C     RELHMU - RELATIVE HUMIDITY IN PERCENT BELOW THE CANOPY (DEFAULT=
C              RELHMO).
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C                                                                      S0102290
C     DFUSIV - DIFFUSIVITY OF EVAPORATING VAPOR INTO THE AIR AT THE     S0102300
C              DROP TEMPERATURE (CM**2/SEC). INPUT ONLY IF DROP LIQUID  S0102310
C              IS NOT WATER. IF NOT WATER AND DFUSIV IS OMITTED THE     S0102320
C              PROGRAM DEFAULTS DFUSIV, ASSUMING SIMILAR TO WATER, VIA -S0102330
C                                                                      S0102340
C              DFUSIV=0.211*(((DRPTMP+273.16)/273.16)**1.94)*(1013.25/  S0102350
C                     AIRPRS)                                          S0102360
C                                                                      S0102370
C              WHERE :  DRPTMP = CALCULATED DROP TEMPERATURE.          S0102380
C                                                                      S0102390
C     HETLAT - LATENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE      S0102400
C              (CAL/MOLE). INPUT ONLY IF LIQUID IS NOT WATER. IF OMITTEDS0102410
C              AND LIQUID IS NOT WATER THE PROGRAM DEFAULTS HETLAT,     S0102420
C              ASSUMING SIMILAR TO WATER, VIA -                        S0102430
C                                                                      S0102440
C              HETLAT=597.3*((273.16/(DRPTMP+273.16))**(0.107+3.67E-4*  S0102450
C                     (DRPTMP+273.16)))*VAPMOL                         S0102460
C                                                                      S0102470
C              WHERE :  DRPTMP = CALCULATED DROP TEMPERATURE.          S0102480
C                                                                      S0102490
C              * NOTE - THE DEFAULT VALUE CALCULATED HERE IS NOT        S0102500
C              *        RECOMMENDED FOR LIQUIDS VERY DIFFERENT FROM     S0102510
C              *        WATER.                                         S0102520
C                                                                      S0102530
C     CONMOL - MOLAL CONCENTRATION OF THE AIR-LIQUID MIXTURE (MOLES/    S0102540
C              CM**3). INPUT ONLY IF DROP LIQUID IS NOT WATER. IF       S0102550
C              OMITTED AND LIQUID IS NOT WATER, THE PROGRAM DEFAULTS    S0102560
C              CONMOL VIA -                                            S0102570
C                                                                      S0102580
C              CONMOL=(AIR DENSITY)/AIRMOL                             S0102590
C                                                                      S0102600
C              WHERE : THE AIR DENSITY IS INPUT OR CALCULATED BY THE    S0102610
C                      PROG.                                           S0102620
C                                                                      S0102630
C     THERMC - THERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT THE DROP   S0102640
C              TEMPERATURE (CAL/(SEC.CM.DEGREES K)). INPUT ONLY IF DROP S0102650
C              LIQUID IS NOT WATER. IF NOT WATER AND THERMC IS OMITTED, S0102660
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C                THE PROGRAM DEFAULTS THERMC, ASSUMING DRY AIR, VIA -      S0102670
C                                                                          S0102680
C                THERMC= A*(1.0-(1.17-1.02*(B/A)))*VAPINF/AIRPRS           S0102690
C                                                                          S0102700
C                WHERE :  A = 5.69E-5+1.7E-7*DRPTMP                        S0102710
C                         B = 3.78E-5+2.0E-7*DRPTMP                        S0102720
C                    DRPTMP = CALCULATED DROP TEMP. (DEG K)                S0102730
C                    VAPINF = VAPOR PRESSURE OF THE VAPOR                  S0102740
C                                 AT INFINITY (MB)                         S0102750
C                    AIRPRS = BAROMETRIC PRESSURE (MB)                     S0102760
C                                                                          S0102770
C       VAPINF - VAPOR PRESSURE OF THE EVAPORATING VAPOR AT INFINITY       S0102780
C                (MILLIBARS). INPUT ONLY IF THE DROP LIQUID IS NOT WATER.  S0102790
C                IF NOT WATER AND VAPINF IS OMITTED, THE PROGRAM DEFAULTS  S0102800
C                VAPINF TO -                                               S0102810
C                                                                          S0102820
C            VAPINF = 0.01*A*(575.0466+T*(31.82291+T*1.296028))/           S0102830
C                     (93.51611-T)                                         S0102840
C                                                                          S0102850
C            WHERE : T = AIRTPO ABOVE THE CANOPY AND AIRTPU BELOW          S0102860
C                        THE CANOPY                                        S0102870
C                    A = RELHMO ABOVE THE CANOPY AND RELHMU BELOW          S0102880
C                        THE CANOPY                                        S0102890
C                                                                          S0102900
C       BCONST,CCONST - CONSTANTS USED IN THE EQUATION THAT DESCRIBES      S0102910
C                       THE VAPOR PRESSURE OF THE NON-WATER LIQUID AS A    S0102920
C                       FUNCTION OF TEMPERATURE. THE EQUATION IS -         S0102930
C                                                                          S0102940
C                VAPOR PRESSURE=EXP(BCONST-CCONST/(DRPTMP))                S0102950
C                                                                          S0102960
C                WHERE :  DRPTMP = CALCULATED DROP TEMPERATURE (DEG K)     S0102970
C                                                                          S0102980
C                INPUT ONLY IF LIQUID IS NOT WATER. IF LIQUID IS NOT WATERS0102990
C                AND BCONST AND CCONST ARE OMITTED THE PROGRAM DEFAULTS TOS0103000
C                21.07 AND 5249.9, RESPECTIVELY.                           S0103010
C                                                                          S0103020
C-IF ISW(2) = 2                                                            S0103030
C                                                                          S0103040
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C      DAU,DBU,DCU - ARRAYS OF COEFFICIENTS OF THE QUADRATIC EQUATION     S0103050
C                    THAT GIVES THE DROP DIAMETER IN MICROMETERS AS A     S0103060
C                    FUNCTION OF TIME ABOVE THE CANOPY. THERE ARE A       S0103070
C                    MAXIMUM OF 20 VALUES FOR EACH ARRAY. THE ORDER OF    S0103080
C                    VALUES IN EACH ARRAY IS IN DESCENDING ORDER OF       S0103090
C                    DROP SIZE. THERE ARE NO DEFAULT VALUES FOR THESE     S0103100
C                    PARAMETERS. THE NUMBER OF DROP SIZE CATEGORIES       S0103110
C                    IS DETERMINED BY THE NUMBER OF NON-ZERO VALUES OF    S0103120
C                    DAU AND DBU INPUT. THE EQUATION IS -                 S0103130
C                                                                         S0103140
C                          DROP = DAU(J) + DBU(J)*T + DCU(J)*T**2         S0103150
C                    WHERE:                                               S0103160
C                           DROP IS DIAMETER IN MICROMETERS.              S0103170
C                           J IS THE INDEX OVER DROP SIZE CATEGORIES.     S0103180
C                           T IS TIME IN SECONDS FROM RELEASE TIME.       S0103190
C                                                                         S0103200
C      DAL,DBL,DCL - ARRAYS OF COEFFICIENTS OF THE QUADRATIC EQUATION     S0103210
C                    THAT GIVES THE DROP DIAMETER IN MICROMETERS AS A     S0103220
C                    FUNCTION OF TIME BELOW THE CANOPY. THERE ARE A       S0103230
C                    MAXIMUM OF 20 VALUES FOR EACH ARRAY. THE ORDER OF    S0103240
C                    VALUES IN EACH ARRAY IS IN DESCENDING ORDER OF       S0103250
C                    DROP SIZE. (DEFAULT=DAU,DBU,DCU). THE EQUATION IS - S0103260
C                                                                         S0103270
C                          DROP = DAL(J) + DBL(J)*T + DCL(J)*T**2         S0103280
C                    WHERE:                                               S0103290
C                           DROP IS DIAMETER IN MICROMETERS.              S0103300
C                           J IS THE INDEX OVER DROP SIZE CATEGORIES.     S0103310
C                           T IS TIME IN SECONDS FROM RELEASE TIME.       S0103320
C                                                                         S0103330
C***************- INPUTS DEPENDING ON ISW(3)                               S0103340
C                                                                         S0103350
C-IF ISW(3) >= 1                                                          S0103360
C                                                                         S0103370
C      WSIN14 - WIND SPEED IN BOTTOM QUARTER OF FOREST CANOPY IN METERS/ S0103380
C               SECOND (DEFAULT = WSIN24).                                S0103390
C                                                                         S0103400
C      WSIN24 - WIND SPEED IN SECOND QUARTER OF FOREST CANOPY IN METERS/ S0103410
C               SECOND (DEFAULT = WSIN34).                                S0103420
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C                                                                       S0103430
C     WSIN34 - WIND SPEED IN THIRD QUARTER OF FOREST CANOPY IN METERS/  S0103440
C              SECOND (DEFAULT = WSIN44).                               S0103450
C                                                                       S0103460
C     WSIN44 - WIND SPEED IN TOP QUARTER OF FOREST CANOPY IN METERS/    S0103470
C              SECOND (DEFAULT = WSOCAN).                               S0103480
C                                                                       S0103490
C     HGTCAN - ARRAY OF FOREST CANOPY HEIGHTS FOR UP TO 3 FOREST HEIGHT S0103500
C              (STORY) CLASSES. THE VALUES MUST BE INPUT IN WHOLE METERSS0103510
C              IN DESCENDING ORDER OF HEIGHT (NO DEFAULT). THE NUMBER OFS0103520
C              STORIES IS DETERMINED BY THE NUMBER OF NON-ZERO VALUES   S0103530
C              INPUT.                                                   S0103540
C                                                                       S0103550
C     PRBPEN - ARRAY GIVING THE PROBABILITY OF DROP PENETRATION         S0103560
C              HORIZONTALLY THROUGH A TREE (STEM) FOR EACH FOREST       S0103570
C              HEIGHT (STORY) CLASS. FRACTION FROM 0 TO 1 (NO DEFAULTS).S0103580
C                                                                       S0103590
C     TREDEN - ARRAY GIVING THE TREE DENSITIES IN TREES/ACRE            S0103600
C              (STEMS ACRE) FOR EACH FOREST HEIGHT (STORY) CLASS        S0103610
C              DEFINED BY HGTCAN (NO DEFAULTS).                         S0103620
C                                                                       S0103630
C     COLEFF - ARRAY GIVING THE COLLECTION EFFICIENCES FOR EACH DROP    S0103640
C              SIZE CATEGORY. FRACTION FROM 0 TO 1 (NO DEFAULTS).       S0103650
C                                    - OR -                             S0103660
C              ARRAY GIVING THE DIAMETERS IN CENTIMETERS OF THE         S0103670
C              VEGETATIVE ELEMENTS REPRESENTATIVE OF EACH FOREST HEIGHT S0103680
C              CLASS (DEFAULT=-13). THESE VALUES ARE INPUT AS NEGATIVE  S0103690
C              DIAMETERS. THE PROGRAM WILL THEN CALCULATE THE COLLECTIONS0103700
C              EFFICIENCY USING SELL'S EQUATION -                       S0103710
C                                                                       S0103720
C                   ( (2.8E-4 * D(J)**2 * U)/S : IF EFF <= 1.0          S0103730
C                  EFF =(                                               S0103740
C                   ( 1.0                      : IF EFF > 1.0           S0103750
C               WHERE:                                                  S0103760
C                  EFF = COLLECTION EFFICIENCY                          S0103770
C                  U = CALCULATED IMPACTION VELOCITY IN M/S             S0103780
C                  D(J) = CALCULATED DROP DIAMETER FOR THE JTH          S0103790
C                         DROP SIZE CATEGORY IN MICROMETERS.            S0103900
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      C                        S = DIAMETER IN CM OF THE VEGETATIVE ELEMENT     S0103810
      C                            ON WHICH THE DROP IMPACTS.                   S0103820
      C                                                                         S0103830
      C     TREENV - ARRAY GIVING THE TREE ENVELOPE (WIDTH) AT EACH METER OF    S0103840
      C              TREE HEIGHT FOR EACH FOREST HEIGHT CLASS FROM ONE METER    S0103850
      C              ABOVE THE GROUND TO THE TOP OF THE TREE HEIGHT. THE FIRSTS0103860
      C              HGTCAN(1) VALUES INPUT ARE FOR FOREST HEIGHT 1, THE        S0103870
      C              SECOND HGTCAN(2) VALUES ARE FOR HEIGHT 2 AND THE LAST      S0103880
      C              HGTCAN(3) FOR THE THIRD FOREST HEIGHT CLASS. THE ENVELOPES0103890
      C              WIDTHS ARE INPUT IN METERS. THE MAXIMUM NUMBER OF VALUES S0103900
      C              THAT CAN BE INPUT IS GIVEN BY - HGTCAN(1)+HGTCAN(2)+       S0103910
      C              HGTCAN(3)<=100 (NO DEFAULTS).                              S0103920
      C              NOTE THAT THE VALUES OF HGTCAN ARE HERE TREATED AS         S0103930
      C              INTEGERS.                                                  S0103940
      C                                                                         S0103950
      C***************- INPUTS DEPENDING ON ISW(4)                              S0103960
      C                                                                         S0103970
      C     NSOURC - TOTAL NUMBER OF LINE SOURCES (AIRCRAFT SPRAY LINES),       S0103980
      C              (MAXIMUM=100, DEFAULT=1).                                  S0103990
      C                                                                         S0104000
      C     NXPNTS - NUMBER OF X (EAST-WEST) RECEPTOR COORDINATES IN THE        S0104010
      C              RECTANGULAR RECEPTOR GRID SYSTEM. (NXPNTS+NYPNTS+          S0104020
      C              2*NXYPNT<=100 AND NXPNTS*NYPNTS+NXYPNT<=737) (NO DEFAULT)S0104030
      C                                                                         S0104040
      C     NYPNTS - NUMBER OF Y (NORTH-SOUTH) RECEPTOR COORDINATES IN THE      S0104050
      C              RECTANGULAR RECEPTOR GRID SYSTEM  (NXPNTS+NYPNTS+          S0104060
      C              2*NXYPNT<=100 AND NXPNTS*NYPNTS+NXYPNT<=737) (NO DEFAULT)S0104070
      C                                                                         S0104080
      C     NXYPNT - NUMBER OF DISCRETE (ARBITRARILY PLACED) RECTANGULAR        S0104090
      C              RECEPTOR COORDINATES (NXPNTS+NYPNTS+2*NXYPNT<=100 AND      S0104100
      C              NXPNTS*NYPNTS+NXYPNT<=737) (NO DEFAULT).                   S0104110
      C                                                                         S0104120
      C     Q - EMISSION OF SPRAY MATERIAL IN GRAMS/METER OR GALLONS/ACRE       S0104130
      C         DEPENDING ON THE INPUT PARAMETER SWATH.                         S0104140
      C         IF THE PARAMETER SWATH IS GREATER THAN ZERO, THE PROGRAM        S0104150
      C         ASSUMES Q IS IN GALLONS/ACRE AND THE AREA SPRAYED IS SPRAYED    S0104160
      C         IN LINES OF AN EQUAL DISTANCE (SWATH) APART. IF THE SPRAY       S0104170
      C         LINES ARE NOT UNIFORM OR THE AREA IS NOT REGULAR INPUT Q IN     S0104180
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C           GRAMS/METER AND SET SWATH TO 0.0 OR OMIT SWATH FROM THE INPUTSS0104190
C           (DEFAULT=1.0). THE EQUATION USED TO CONVERT GALLONS/ACRE TO   S0104200
C           GRAMS/METER BY THE PROGRAM IS -                               S0104210
C                                                                         S0104220
C            Q(G/M) = 9.352938E-1(ACRE.CM**3/GAL.M**2)*DENLIQ(G/CM**3)*   S0104230
C                     SWATH(M)*Q(GAL/ACRE)                                S0104240
C                                                                         S0104250
C           WHERE :   DENLIQ = INPUT LIQUID DENSITY.                      S0104260
C                     SWATH = INPUT SWATH WIDTH.                          S0104270
C                     Q = INPUT EMISSION STRENGTH.                        S0104280
C                                                                         S0104290
C       SWATH - DISTANCE BETWEEN SPRAY LINES IN METERS WHEN Q IS INPUT IN S0104300
C               UNITS OF GALLONS/ACRE. IF Q IS INPUT IN GRAMS/METER       S0104310
C               OMIT SWATH OR SET SWATH TO 0.0 (DEFAULT=0.0).             S0104320
C                                                                         S0104330
C       Z - HEIGHT ABOVE GROUND OF DOSAGE, CONCENTRATION AND DEPOSITION   S0104340
C           CALCULATIONS IN METERS. NOTE THAT DOSAGE AND CONCENTRATION    S0104350
C           CAN ONLY BE CALCULATED AT Z >= HGTCAN(1) (DEFAULT=0.0).       S0104360
C                                                                         S0104370
C       SIGAP - STANDARD DEVIATION OF THE WIND DIRECTION ANGLE (RADIANS ORS0104380
C               DEGREES: IF < 1, RADIANS ASSUMED: IF >= 1, DEGREES        S0104390
C               ASSUMED) (NO DEFAULT).                                    S0104400
C                                                                         S0104410
C       SIGEP - STANDARD DEVIATION OF THE WIND ELEVATION ANGLE (RADIANS ORS0104420
C               DEGREES: IF < 1, RADIANS ASSUMED: IF >= 1, DEGREES        S0104430
C               ASSUMED) (NO DEFAULT).                                    S0104440
C                                                                         S0104450
C       TAU - TIME TO SPRAY CLOUD STABILIZATION IN SECONDS (DEFAULT=2.5). S0104460
C                                                                         S0104470
C       TAUO - MEASUREMENT TIME FOR SIGAP IN SECONDS (DEFAULT=600).       S0104480
C                                                                         S0104490
C       SIGXYZ - STANDARD DEVIATION OF THE SOURCE MATERIAL DISTRIBUTION   S0104500
C                ALONG THE SPRAY LINE IN METERS (DEFAULT=WNGSPN/4.3).     S0104510
C                                                                         S0104520
C       DECAY - COEFFICIENT OF TIME DEPENDENT EXPONENTIAL DECAY FOR THE   S0104530
C               REMOVAL OF MATERIAL DUE TO CHEMICAL OR PHYSICAL PROCESSES.S0104540
C               DECAY IS IN UNITS OF PER SECOND (DEFAULT = 0.0). THE      S0104550
C               FRACTION OF MATERIAL LEFT AFTER TIME T IS GIVEN BY -      S0104560
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```
C                   FRACTION = EXP(-DECAY*T)                             S0104570
C            SO IF THE HALF LIFE OF THE MATERIAL IS 3600 SECONDS, THEN S0104580
C            DECAY = 1.92541E-4.                                         S0104590
C                                                                        S0104600
C     XLRZ - LATERAL AND VERTICAL REFERENCE DISTANCE IN METERS. THIS     S0104610
C            PARAMETER IS NORMALLY CALCULATED BY THE PROGRAM. HOWEVER    S0104620
C            IF XLRZ IS INPUT GREATER THAN OR EQUAL TO ZERO, THE INPUT   S0104630
C            VALUE IS USED.                                              S0104640
C                                                                        S0104650
C     DELU - WIND-SPEED SHEAR ABOVE THE CANOPY IN METERS PER SECOND      S0104660
C            (DEFAULT=0.0).                                              S0104670
C                                                                        S0104680
C     HM - MIXING LAYER HEIGHT ABOVE GROUND IN METERS (NO DEFAULT).      S0104690
C                                                                        S0104700
C     THETA - WIND DIRECTION IN DEGREES. THIS IS THE DIRECTION FROM      S0104710
C             WHICH THE WIND IS BLOWING, WHERE 0 DEGREES IS NORTH AND    S0104720
C             90 DEGREES IS EAST (NO DEFAULT).                           S0104730
C                                                                        S0104740
C     DAREA - AREA ASSIGNMENT FOR DISCRETE RECEPTOR POINTS FOR THE AREA S0104750
C             COVERAGE OF DOSAGE, CONCENTRATION AND/OR DEPOSITION IN     S0104760
C             SQUARE METERS (DEFAULT=10000 SQUARE METERS).               S0104770
C                                                                        S0104780
C     BETA1 - RATIO OF LAGRANGIAN TO EULERIAN TIME-SCALES USED IN THE    S0104790
C             CORRECTION FACTOR ON SIGEP AND SIGAP FOR CROSSING-         S0104800
C             TRAJECTORY EFFECTS OF HEAVY DROPS (DEFAULT=0.0 OR          S0104810
C             NO CORRECTION) (SUGGESTED VALUE FOR BETA1, IF USED,        S0104820
C             IS 1.0). THIS VALUE IS AUTOMATICALLY SET TO 0.0 IF         S0104830
C             EVAPORATION IS BEING USED (ISW(2)>=1).                     S0104840
C             IF BETA1 = 0.0 OR VS/(SIGEP*WSOCAN) <= .2386 THE           S0104850
C                        CORRECTION IS NOT APPLIED TO SIGAP AND SIGEP.   S0104860
C             IF BETA1 > 0.0 AND VS/(SIGEP*WSOCAN) > .2386 THE           S0104870
C                        CORRECTION FACTOR IS APPLIED USING THE          S0104880
C                        EQUATIONS -                                     S0104890
C                                                                        S0104900
C             SIGEPR = SIGEP/(1.0+(BETA1*VS/(WSOCAN*SIGEP))**2)**.25     S0104910
C             SIGAPR = SIGAP/(1.0+4.0*(BETA1*VS/(WSOCAN*SIGEP))**2)**.25S0104920
C           WHERE :                                                      S0104930
C                 SIGEP = INPUT VALUE                                    S0104940
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C                 SIGAP = INPUT VALUE                                   S0104950
C                    VS = CALCULATED DROP SETTLING VELOCITY             S0104960
C                WSOCAN = INPUT WIND SPEED                              S0104970
C                                                                       S0104980
C      X - ARRAY OF NXPNTS X COORDINATES DEFINING THE (WEST TO EAST)    S0104990
C          AXIS OF THE RECTANGULAR COORDINATE SYSTEM IN METERS.         S0105000
C          INPUT IN ASCENDING ORDER OF MAGNITUDE (NEG. TO POS.).        S0105010
C          FOLLOW THE LAST X AXIS POINT BY NXYPNT DISCRETE (ARBITRARILY  S0105020
C          PLACED RECEPTOR COORDINATES IN METERS (NO DEFAULTS).         S0105030
C                                                                       S0105040
C      Y - ARRAY OF NYPNTS Y COORDINATES DEFINING THE (SOUTH TO NORTH)  S0105050
C          AXIS OF THE RECTANGULAR COORDINATE SYSTEM IN METERS.         S0105060
C          INPUT IN ASCENDING ORDER OF MAGNITUDE (NEG. TO POS.). FOLLOW S0105070
C          THE LAST Y AXIS COORDINATE WITH NXYPNT DISCRETE (ARBITRARILY S0105080
C          PLACED) Y RECEPTOR COODINATES IN METERS (NO DEFAULTS).       S0105090
C                                                                       S0105100
C      DX - ARRAY OF START AND END X (EAST-WEST) COORDINATES OF THE LINE S0105110
C          SOURCES IN METERS. INPUT THE START AND END POINTS OF THE FIRSTS0105120
C          SOURCE, FOLLOWED BY THE START AND END POINTS OF THE SECOND,  S0105130
C          ETC. THERE ARE 2*NSOURC VALUES READ (NO DEFAULTS).           S0105140
C                                                                       S0105150
C      DY - ARRAY OF START AND END Y (NORTH-SOUTH) COORDINATES OF THE   S0105160
C           LINE SOURCES IN METERS. INPUT THE START AND END POINTS OF THES0105170
C           FIRST SOURCE, FOLLOWED BY THE START AND END POINTS OF THE   S0105180
C           SECOND, ETC. THERE ARE 2*NSOURC POINTS READ (NO DEFAULTS).  S0105190
C                                                                       S0105200
C      PCTMAT - ARRAY OF FRACTION OF TOTAL SPRAY MATERIAL IN EACH DROP  S0105210
C              SIZE CATEGORY (FRACTION, 0 TO 1). (MAXIMUM OF 20 VALUES).S0105220
C              (NO DEFAULTS)                                            S0105230
C                                                                       S0105240
C      GAMA, GAMB, GAMC - ARRAYS OF COEFFICIENTS OF THE QUADRATIC       S0105250
C            EQUATION THAT GIVES THE FRACTION OF MATERIAL REFLECTED     S0105260
C            AT THE SURFACE AS A FUNCTION OF THE DROP SETTLING VELOCITY. S0105270
C                                                                       S0105280
C            FRACTION = GAMA(J)+GAMB(J)*VS+GAMC(J)*VS**2                S0105290
C            WHERE: VS IS THE DROP SETTLING VELOCITY IN METERS/SEC.     S0105300
C                   (1      ,IF VS )= VSGAM(1)                          S0105310
C               J = (2      ,IF VS )= VSGAM(2) & VS < VSGAM(1)          S0105320
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C                 (3     ,IF VS <  VSGAM(2)                               S0105330
C                                                                          S0105340
C         THREE COEFFICIENTS OF GAMA, GAMB AND GAMC EACH MUST BE INPUTS0105350
C         THE FIRST VALUE OF EACH ARRAY IS FOR SETTLING VELOCITIES     S0105360
C         GREATER THAN OR EQUAL TO VSGAM(1). THE SECOND VALUE OF EACH S0105370
C         ARRAY IS FOR SETTLING VELOCITIES LESS THAN VSGAM(1) AND      S0105380
C         GREATER THAN OR EQUAL TO VSGAM(2). THE THIRD VALUE OF EACH  S0105390
C         ARRAY IS FOR SETTLING VELOCITIES LESS THAN VSGAM(2). THE     S0105400
C         DEFAULT VALUES FOR THE THREE ARRAYS ARE -                    S0105410
C         GAMA(1)=0.75, GAMA(2)=0.83465302, GAMA(3)=.91639996          S0105420
C         GAMB(1)=-2.5, GAMB(2)=-6.9031391, GAMB(3)=-22.357124         S0105430
C         GAMC(1)=0.00, GAMC(2)=57.4092560, GAMC(3)=821.426510         S0105440
C                                                                      S0105450
C     VSGAM - ARRAY OF TWO SETTLING VELOCITIES THAT SPECIFY THE        S0105460
C         SETTLING VELOCITIES THAT BREAK THE CURVE OF SURFACE          S0105470
C         REFLECTION COEFFICIENTS GIVEN BY GAMA, GAMB AND GAMC INTO    S0105480
C         THREE PARTS (METERS/SEC). VS VALUES GREATER THAN OR EQUAL TOS0105490
C         VSGAM(1) USE GAMA(1), GAMB(1) AND GAMC(1) TO CALCULATE THE  S0105500
C         SURFACE REFLECTION COEFFICIENT. VS VALUES LESS THAN VSGAM(1)S0105510
C         BUT GREATER THAN OR EQUAL TO VSGAM(2) USE GAMA(2), GAMB(2)  S0105520
C         AND GAMC(2) TO CALCULATE THE SURFACE REFLECTION COEFFICIENT.S0105530
C         VS VALUES LESS THAN VSGAM(2) USE GAMA(3), GAMB(3) AND        S0105540
C         GAMC(3) TO CALCULATE THE SURFACE REFLECTION COEFFICIENT. THES0105550
C         DEFAULT VALUES FOR VSGAM ARE - VSGAM(1)= .04, VSGAM(2)=.012.S0105560
C                                                                      S0105570
C     DOSLV - ARRAY OF DOSAGE LEVELS IN OUTPUT DOSAGE UNITS FOR THE    S0105580
C           CALCULATION OF AREA OF COVERAGE OF DOSAGE (MAXIMUM OF      S0105590
C           10 VALUES) (NO DEFAULTS).                                  S0105600
C                                                                      S0105610
C     CONLV - ARRAY OF CONCENTRATION LEVELS IN OUTPUT CONCENTRATION    S0105620
C           UNITS FOR THE CALCULATION OF AREA OF COVERAGE OF           S0105630
C           CONCENTRATION (MAXIMUM OF 10 VALUES) (NO DEFAULTS).        S0105640
C                                                                      S0105650
C     DEPLV - ARRAY OF DEPOSITION LEVELS IN OUTPUT DEPOSITION UNITS    S0105660
C           FOR THE CALCULATION OF AREA OF COVERAGE OF DEPOSITION      S0105670
C           (MAXIMUM OF 10 VALUES) (NO DEFAULTS).                      S0105680
C                                                                      S0105690
C                                                                      S0105700
```

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C***************- FSCBG INPUT DATA MODE -***************************     S0105710
C                                                                        S0105720
C***************- BATCH MODE VIA NAMELIST QLST1                          S0105730
C                                                                        S0105740
C     THE DATA DECK MUST BEGIN WITH $QLST1 TYPED IN COLUMNS 2 THROUGH    S0105750
C     7, FOLLOWED BY AT LEAST 1 BLANK. SOME COMPUTERS USE THE * SYMBOL   S0105760
C     RATHER THAN $. THE DATA DECK MUST END WITH $END TYPED IN ANY OF    S0105770
C     COLUMNS 2 THROUGH 77 AND MUST BE PRECEEDED WITH AT LEAST ONE       S0105780
C     BLANK. DATA VALUES ARE ENTERED BY TYPING THE NAME OF THE PARAMETERS0105790
C     FOLLOWED BY = FOLLOWED BY VALUE (DECIMAL OR INTEGER) FOLLOWED BY   S0105800
C     A COMMA WITH NO INTERVENING BLANKS. ARRAY ITEM VALUES ARE TYPED    S0105810
C     ACROSS THE INPUT IMAGE WITH A SEPARATING COMMA BETWEEN VALUES.     S0105820
C     MULTIPLE VALUES THAT ARE THE SAME CAN BE TYPED K*####, WHERE K     S0105830
C     DENOTES THE NUMBER OF OCCURRENCES OF THE VALUE. HOLLERITH          S0105840
C     PARAMETERS SUCH AS TITLE ARE INPUT BY NAME (TITLE) FOLLOWED BY     S0105850
C     = FOLLOWED BY THE NUMBER OF HOLLERITH CHARACTERS FOLLOWED BY AN    S0105860
C     H FOLLOWED BY THE CHARACTER STRING FOLLOWED BY A COMMA. VALUES     S0105870
C     OMITTED FROM THE INPUT DECK ASSUME THEIR DEFAULT VALUES.           S0105880
C                                                                        S0105890
C                                                                        S0105900
C                                                                        S0105910
C                                                                        S0105920
C**************** END OF INPUT DATA *************************************S0105930
C                                                                        S0105940
C                                                                        S0105950
C                                                                        S0105960
C                                                                        S0105970
      CALL CBGS1                                                         S0105980
      STOP                                                               S0105990
      END                                                                S0106000
```

```
      BLOCK DATA                                                        S0200010
      COMMON /COM1/ IDUMA(75)                                           S0200020
      COMMON /COM2/ ADUMJ(38),BDUMJ(810),CDUMJ(620)                     S0200030
      COMMON /COM3/ ADUMK(371),BDUMK(525),KDUMA(2),CDUMK(320),DDUMK(1080S0200040
     *)                                                                 S0200050
      DATA IDUMA/5,6,6*0,40*1H ,20*0,7*0/                               S0200060
      DATA ADUMJ/0.5,-1.0E15,3*0.0,1.0,20*0.0,7*0.0,2.5,600.0,0.0       S0200070
     *,-1.0E15,0.0/                                                     S0200080
      DATA BDUMJ/810*0.0/                                               S0200090
      DATA CDUMJ/220*1.0,360*0.0,-1.0E15,4*0.0,10000.0,0.0,.75,         S0200100
     *.83465302,.91639996,-2.5,-6.9031391,-22.357124,0.0,57.409256,     S0200110
     *821.426510,.04,.012,2*0.0,20*1.0/                                 S0200120
      DATA ADUMK/4*-1.E15,1013.25,-1.0E15,21.07,5249.9,2*0.0,18.015,    S0200130
     *-1.E15,-1.E15,3*-1.0E15,28.9644,1.0,                              S0200140
     *49*0.0,3*-13.,17*0.0,103*0.0,120*-1.0E15,17*0.0,1.0,2.0,4.0,6.0,  S0200150
     *10.0,20.0,40.0,60.0,100.0,200.0,400.0,600.0,1.0E3,2.0E3,4.0E3,    S0200160
     *6.0E3,1.0E4,2.0E4,4.0E4,6.0E4,1.0E5,2.0E5,24.0,64.0,140.0,230.0,  S0200170
     *420.0,1160.0,2880.0,5400.0,1.2E4,3.2E4,9.76E4,1.94E5,4.6E5,1.64E6,S0200180
     *6.4E6,1.44E7,4.1E7,1.76E8,7.33E8,1.65E9,4.4E9,1.64E10/            S0200190
      DATA BDUMK/525*0.0/                                               S0200200
      DATA KDUMA/2*0/                                                   S0200210
      DATA CDUMK/320*0.0/                                               S0200220
      END                                                               S0200230
```

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      SUBROUTINE CBGS1                                                  S0300010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGF,ITABLE,IDATE(3),TITLE(40), S0300020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0300030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0300040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0300050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0300060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0300070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0300080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0300090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0300100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0300110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0300120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0300130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S0300140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0300150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0300160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0300170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0300180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0300190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0300200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0300210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0300220
      INTEGER TITLE                                                     S0300230
      DIMENSION IFMT(3)                                                 S0300240
      DIMENSION IDO(1)                                                  S0300250
      EQUIVALENCE (IDO(1),HIO(1))                                       S0300260
      DATA RAD/.01745329/                                               S0300270
      DATA IFMT/2H(3,2HI2,1H)/                                          S0300280
      NAMELIST /QLST1/ ISW,WAKVEL,ARCRWT,SWATH,WNGSPN,ARCRSP,WSOCAN,    S0300290
     *AIRTPO,AIRTPU,AIRPRS,AIRMOL,DENLIQ,VAPMOL,RELHMO,RELHMU,DFUSIV,   S0300300
     *HETLAT,CONMOL,THERMC,VAPINF,BCONST,CCONST,HGTCFT,DRPUPR,DRPLWR,   S0300310
     *HGTCAN,WSIN14,WSIN24,WSIN34,WSIN44,IFWATR,Z,PRBPEN,COLEFF,        S0300320
     *TREDEN,TREENV,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,   S0300330
     *SIGXYZ,XLRZ,HM,Q,DX,DY,X,Y,PCTMAT,TITLE,THETA,DEPLV,              S0300340
     *DOSLV,CONLV,DAREA,BETA1,AIRDEN,DAU,DBU,DCU,DECAY,VSGAM,GAMA,      S0300350
     *GAMB,GAMC,DELU                                                    S0300360
C                                                                       S0300370
C                                                                       S0300380
```

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C                                                                              S0300390
C                                                                              S0300400
      IF (INPFIL .LE. 0) INPFIL = 5                                            S0300410
      IF (IOTFIL .LE. 0) IOTFIL = 6                                            S0300420
C                                                                              S0300430
C                                                                              S0300440
C                                                                              S0300450
C********************************************************************** S0300460
C     READ INPUT DATA                                                          S0300470
C                                                                              S0300480
C     *** BATCH MODE INPUT VIA NAMELIST QLST1 ***                              S0300490
      READ (INPFIL,QLST1)                                                      S0300500
C                                                                              S0300510
C                                                                              S0300520
C                                                                              S0300530
C                                                                              S0300540
C     DEFAULT INPUT PARAMETERS                                                 S0300550
      IF (IFWATR .LE. 0) IFWATR = 1                                            S0300560
      IF (AIRTPU .LE. -1.0E15) AIRTPU = AIRTPO                                 S0300570
      IF (AIRPRS .LE. 0.0) AIRPRS = 1013.25                                    S0300580
      IF (AIRMOL .LE. 0.0) AIRMOL = 28.9644                                    S0300590
      IF (DENLIQ .LE. 0.0) DENLIQ = 1.0                                        S0300600
      IF (VAPMOL .LE. 0.0) VAPMOL = 18.015                                     S0300610
      IF (RELHMU .LE. 0.0) RELHMU = RELHMO                                     S0300620
      IF (WSIN44 .LE. 0.0) WSIN44 = WSOCAN                                     S0300630
      IF (WSIN34 .LE. 0.0) WSIN34 = WSIN44                                     S0300640
      IF (WSIN24 .LE. 0.0) WSIN24 = WSIN34                                     S0300650
      IF (WSIN14 .LE. 0.0) WSIN14 = WSIN24                                     S0300660
      IF (IFWATR .LE. 1) GO TO 10                                              S0300670
      IF (BCONST .LE. 0.0) BCONST = 21.07                                      S0300680
      IF (CCONST .LE. 0.0) CCONST = 5249.9                                     S0300690
   10 IF (TAU .LE. 0.0) TAU = 2.5                                              S0300700
      IF (TAUO .LE. 0.0) TAUO = 600.0                                          S0300710
      IF (DELU .LT. 0.0) DELU = 0.0                                            S0300720
C     CANNOT USE BETA1 WITH EVAPORATION                                        S0300730
      IF (ISW(2) .GT. 0) BETA1 = 0.0                                           S0300740
      IF (SIGXYZ .LE. 0.0) SIGXYZ = WNGSPN/4.3                                 S0300750
      NVS = 0                                                                  S0300760
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```
      IF (ISW(2) .EQ. 2) GO TO 30                                       S0300770
      DO 20 I=1,20                                                      S0300780
      IF (DRPUPR(I) .GT. 0.0) NVS = NVS+1                               S0300790
      IF (DRPLWR(I) .LE. 0.0) DRPLWR(I) = DRPUPR(I)                     S0300800
   20 CONTINUE                                                          S0300810
      GO TO 60                                                          S0300820
   30 DO 40 I=1,20                                                      S0300830
      IF (DAU(I) .GT. -1.0E15) NVS = NVS+1                              S0300840
   40 CONTINUE                                                          S0300850
      IF (ISW(3) .EQ. 0) GO TO 60                                       S0300860
      DO 50 I=1,20                                                      S0300870
      IF (DAL(I) .LE. -1.0E15) DAL(I) = DAU(I)                          S0300880
      IF (DBL(I) .LE. -1.0E15) DBL(I) = DBU(I)                          S0300890
      IF (DCL(I) .LE. -1.0E15) DCL(I) = DCU(I)                          S0300900
   50 CONTINUE                                                          S0300910
   60 CONTINUE                                                          S0300920
      IF (ISW(9) .NE. 0) GO TO 100                                      S0300930
      T1 = DENLIQ*4.18879                                               S0300940
      DO 90 I=1,NVS                                                     S0300950
      IF (ISW(2) .EQ. 2) GO TO 70                                       S0300960
      RD(1) = DRPUPR(I)                                                 S0300970
      RD(2) = DRPLWR(I)                                                 S0300980
      GO TO 80                                                          S0300990
   70 RD(1) = DAU(I)                                                    S0301000
      RD(2) = DAL(I)                                                    S0301010
   80 RD(1) = RD(1)*5.0E-5                                              S0301020
      RD(2) = RD(2)*5.0E-5                                              S0301030
      T2 = AVGRD(RD(1),RD(2))                                           S0301040
   90 CONV(I) = 1.0/(T1*T2*T2*T2)                                       S0301050
  100 CONTINUE                                                          S0301060
      IF (NSOURC .LE. 0) NSOURC = 1                                     S0301070
      IF (SIGEP .GE. 1.0) SIGEP = SIGEP*RAD                             S0301080
      IF (SIGAP .GE. 1.0) SIGAP = SIGAP*RAD                             S0301090
      IF (DAREA .LE. 0.0) DAREA = 10000.0                               S0301100
C                                                                       S0301110
C     GET DATE - PLACE MONTH IN IDATE(1), DAY IN IDATE(2) AND YEAR IN   S0301120
C                IDATE(3) - ALL INTEGER                                 S0301130
C                                                                       S0301140
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      CALL ADATE(IDO(1),IDO(3))                                          S0301150
      DECODE (IFMT,IDO(1)) IDATE(1),IDATE(2),IDATE(3)                    S0301190
C                                                                        S0301200
C                                                                        S0301210
C                                                                        S0301220
C                                                                        S0301230
      LINE = 0                                                           S0301240
      IPAGE = 0                                                          S0301250
      ITABLE = 0                                                         S0301260
C                                                                        S0301270
C                                                                        S0301280
C                                                                        S0301290
C                                                                        S0301300
  110 CONTINUE                                                           S0301310
      CALL CBGS2                                                         S0301320
      RETURN                                                             S0301330
      END                                                                S0301340
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      SUBROUTINE CBGS2                                                  S0400010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0400020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0400030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0400040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0400050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0400060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0400070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0400080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0400090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0400100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0400110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0400120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0400130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S0400140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0400150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0400160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0400170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0400180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0400190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0400200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0400210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0400220
      INTEGER TITLE                                                     S0400230
      CALL IOPUT(1,1,0)                                                 S0400240
      WRITE (IOTFIL,9001)                                               S0400250
      WRITE (IOTFIL,9002) ISW,IFWATR,WNGSPN,WSOCAN,HGTCFT,DENLIQ,AIRTPO,S0400260
     *AIRTPU,AIRDEN                                                     S0400270
      IF (AIRDEN .GT. 0.0) GO TO 10                                     S0400280
      WRITE (IOTFIL,9003) AIRMOL,AIRPRS,VAPINF                          S0400290
   10 IF (VAPINF .GE. 0.0) GO TO 20                                     S0400300
      WRITE (IOTFIL,9004) RELHMO,RELHMU                                 S0400310
   20 WRITE (IOTFIL,9005)                                               S0400320
      IF (ISW(1) .EQ. 0) GO TO 30                                       S0400330
      WRITE (IOTFIL,9006) ARCRWT,ARCRSP                                 S0400340
      GO TO 40                                                          S0400350
   30 WRITE (IOTFIL,9007) WAKVEL                                        S0400360
   40 WRITE (IOTFIL,9008)                                               S0400370
      IF (ISW(2) .EQ. 2) GO TO 50                                       S0400380
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      WRITE (IOTFIL,9009) (DRPUPR(I),I=1,NVS)
      WRITE (IOTFIL,9010) (DRPLWR(I),I=1,NVS)
      IF (ISW(2) .EQ. 0) GO TO 60
      WRITE (IOTFIL,9011) AIRPRS,AIRMOL,VAPMOL,RELHMO,RELHMU
      IF (IFWATR .LE. 1) GO TO 60
      WRITE (IOTFIL,9012) DFUSIV,HETLAT,CONMOL,THERMC,VAPINF,BCONST,
     *CCONST
      GO TO 60
   50 WRITE (IOTFIL,9013) (DAU(I),I=1,NVS)
      WRITE (IOTFIL,9014) (DBU(I),I=1,NVS)
      WRITE (IOTFIL,9015) (DCU(I),I=1,NVS)
      IF (ISW(3) .EQ. 0) GO TO 60
      WRITE (IOTFIL,9016) (DAL(I),I=1,NVS)
      WRITE (IOTFIL,9017) (DBL(I),I=1,NVS)
      WRITE (IOTFIL,9018) (DCL(I),I=1,NVS)
   60 IF (ISW(3) .EQ. 0) GO TO 100
      LINE = 57
      CALL IOPUT(0,1,0)
      WRITE (IOTFIL,9019)
      WRITE (IOTFIL,9020) WSIN14,WSIN24,WSIN34,WSIN44,HGTCAN,PRBPEN,
     *TREDEN
      IF (COLEFF(1) .LT. 0.0) GO TO 70
      WRITE (IOTFIL,9021) (COLEFF(I),I=1,NVS)
      GO TO 80
   70 XDO(1) = ABS(COLEFF(1))
      XDO(2) = ABS(COLEFF(2))
      XDO(3) = ABS(COLEFF(3))
      WRITE (IOTFIL,9022) (XDO(I),I=1,3)
   80 K = 1
      IF (HGTCAN(2) .GT. 0) K = 2
      IF (HGTCAN(3) .GT. 0) K = 3
      L = 0
      DO 90 N=1,K
      J = HGTCAN(N)
      WRITE (IOTFIL,9023) N,(TREENV(I+L),I=1,J)
   90 L = L+J
  100 IF (ISW(4) .EQ. 0) GO TO 140
      LINE = 57
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      CALL IOPUT(0,1,0)
      WRITE (IOTFIL,9024)
      WRITE (IOTFIL,9025) NSOURC,NXPNTS,NYPNTS,NXYPNT
      IF (SWATH .LE. 0.0) GO TO 110
      WRITE (IOTFIL,9026) Q,SWATH
      GO TO 120
  110 WRITE (IOTFIL,9027) Q
  120 WRITE (IOTFIL,9028) Z,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,DECAY
      WRITE (IOTFIL,9029) XLRZ,HM,THETA,DAREA,BETA1,DELU
      IF (NXPNTS .GT. 0) WRITE (IOTFIL,9030) (X(I),I=1,NXPNTS)
      IF (NYPNTS .GT. 0) WRITE (IOTFIL,9031) (Y(I),I=1,NYPNTS)
      IF (NXYPNT .LE. 0) GO TO 130
      WRITE (IOTFIL,9032) (X(I+NXPNTS),I=1,NXYPNT)
      WRITE (IOTFIL,9033) (Y(I+NYPNTS),I=1,NXYPNT)
  130 J = 2*NSOURC
      WRITE (IOTFIL,9034) (DX(I),I=1,J)
      WRITE (IOTFIL,9035) (DY(I),I=1,J)
      WRITE (IOTFIL,9036) (PCTMAT(I),I=1,NVS)
      WRITE (IOTFIL,9037) (VSGAM(I),I=1,2)
      WRITE (IOTFIL,9038) GAMA,GAMB,GAMC
      IF (ISW(12) .LE. 0) GO TO 140
      IF (ISW(6) .GT. 0) WRITE (IOTFIL,9039) (DOSLV(I),I=1,10)
      IF (ISW(7) .GT. 0) WRITE (IOTFIL,9040) (CONLV(I),I=1,10)
      IF (ISW(8) .GT. 0) WRITE (IOTFIL,9041) (DEPLV(I),I=1,10)
  140 CONTINUE
  150 CONTINUE
      IF (SWATH .GT. 0.0) Q = Q*DENLIQ*SWATH*9.352939E-1
  160 CONTINUE
      CALL CBGS3
      RETURN
 9001 FORMAT (10X,33H*** INPUTS USED BY ALL MODELS ***)
 9002 FORMAT (05X,24HPROGRAM OPTIONS, (ISW) =,20I2/
     *05X,62HIS LIQUID WATER OR NON-WATER, 2=NON-WATER, 1=WATER, (IFWATR
     *) =,I2/05X,38HAIRCRAFT WING SPAN (WNGSPN (METERS)) =,F7.2/
     *05X,40HWIND SPEED ABOVE CANOPY (WSOCAN (M/S)) =,F6.3/
     *05X,38HHEIGHT OF AIRCRAFT (HGTCFT (METERS)) =,F7.2/
     *05X,44HDENSITY OF SPRAY LIQUID (DENLIQ (G/CM**3)) =,F9.4/
     *05X,51HAIR TEMPERATURE ABOVE THE CANOPY (AIRTPO (DEG C)) =,F7.3/
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      *05X,51HAIR TEMPERATURE BELOW THE CANOPY (AIRTPU (DEG C)) =,F7.3/  S0401150
      *05X,32HAIR DENSITY (AIRDEN (G/CM**3)) =,F9.4)                     S0401160
 9003 FORMAT (05X,34HMOLECULAR WEIGHT OF AIR (AIRMOL) =,F8.4/            S0401170
      *05X,35HBAROMETRIC PRESSURE (AIRPRS (MB)) =,F7.2/                  S0401180
      *05X,60HVAPOR PRESS OF EVAPORATING VAPOR AT INFINITY (VAPINF (MB)) S0401190
      *=,F7.4)                                                           S0401200
 9004 FORMAT (05X,49HRELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) =,FS0401210
      *7.3/05X,49HRELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) =,F7 3)S0401220
 9005 FORMAT (1H0,9X,55H*** INPUTS USED BY THE WAKE SETTLING VELOCITY MOS0401230
      *DEL ***)                                                          S0401240
 9006 FORMAT (5X,31HAIRCRAFT WEIGHT (ARCRWT (KG)) =,F9.3/                S0401250
      *05X,38HAIRCRAFT GROUND SPEED (ARCRSP (M/S)) =,F8.3)               S0401260
 9007 FORMAT (5X,39HWAKE SETTLING VELOCITY (WAKVEL (M/S)) =,F8.4)        S0401270
 9008 FORMAT (1H0,9X,44H*** INPUTS USED BY THE EVAPORATION MODEL ***)    S0401280
 9009 FORMAT (5X,51HUPPER LIMITS OF DROP DIAMETERS (DRPUPR (MICRO-M)) =/S0401290
      *(05X,7(F8.3,1H,)))                                                S0401300
 9010 FORMAT (05X,51HLOWER LIMITS OF DROP DIAMETERS (DRPLWR (MICRO-M)) =S0401310
      */(05X,7(F8.3,1H,)))                                               S0401320
 9011 FORMAT (05X,35HBAROMETRIC PRESSURE (AIRPRS (MB)) =,F7.2/           S0401330
      *05X,34HMOLECULAR WEIGHT OF AIR (AIRMOL) =,F8.4/                   S0401340
      *05X,48HMOLECULAR WEIGHT OF EVAPORATING VAPOR (VAPMOL) =,F8.4/     S0401350
      *05X,49HRELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) =,F7.3/    S0401360
      *05X,49HRELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) =,F7.3)    S0401370
 9012 FORMAT (05X,53HDIFFUSIVITY OF EVAPORATING VAPOR (DFUSIV (CM/S**2))S0401380
      * =,E12.6/                                                         S0401390
      *05X,49HLATENT HEAT OF VAPORIZATION (HETLAT (CAL/MOLE)) =,F12.6/   S0401400
      *05X,55HMOLAL CONCENTRATION AIR-LIQ MIX (CONMOL (MOLE/CM**3)) =,E12S0401410
      *.6/                                                               S0401420
      *05X,57HTHERMAL CONDUCTIVITY OF VAPOR (THERMC (CAL/S.CM.DEG K)) =,ES0401430
      *11.5/                                                             S0401440
      *05X,60HVAPOR PRESS OF EVAPORATING VAPOR AT INFINITY (VAPINF (MB)) S0401450
      *=,F7.4/                                                           S0401460
      *05X,54HCONSTS TO CALC VAPOR PRESS OF LIQUID (BCONST,CCONST) =,2F8.S0401470
      *2)                                                                S0401480
 9013 FORMAT (1H0,4X,60HABOVE CANOPY COEFFICIENTS OF DROP=DAU+DBU*T+DCU*S0401490
      *T**2 (DAU) =/(10X,5(E11.5,1H,)))                                  S0401500
 9014 FORMAT (05X,60HABOVE CANOPY COEFFICIENTS OF DROP=DAU+DBU*T+DCU*T**S0401510
      *2 (DBU) =/(10X,5(E11.5,1H,)))                                     S0401520
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      9015 FORMAT (05X,60HABOVE CANOPY COEFFICIENTS OF DROP=DAU+DBU*T+DCU*T**S0401530
          *2 (DCU) =/(10X,5(E11.5,1H,)))                                      S0401540
      9016 FORMAT (05X,60HBELOW CANOPY COEFFICIENTS OF DROP=DAL+DBL*T+DCL*T**S0401550
          *2 (DAL) =/(10X,5(E11.5,1H,)))                                      S0401560
      9017 FORMAT (05X,60HBELOW CANOPY COEFFICIENTS OF DROP=DAL+DBL*T+DCL*T**S0401570
          *2 (DBL) =/(10X,5(E11.5,1H,)))                                      S0401580
      9018 FORMAT (05X,60HBELOW CANOPY COEFFICIENTS OF DROP=DAL+DBL*T+DCL*T**S0401590
          *2 (DCL) =/(10X,5(E11.5,1H,)))                                      S0401600
      9019 FORMAT (10X,51H*** INPUTS USED BY THE CANOPY PENETRATION MODEL ***S0401610
          *)                                                                  S0401620
      9020 FORMAT (5X,55HWIND SPEED IN BOTTOM QUARTER OF CANOPY (WSIN14 (M/S)S0401630
          *) =,F6.3/                                                          S0401640
          *05X,55HWIND SPEED IN SECOND QUARTER OF CANOPY (WSIN24 (M/S)) =,F6.S0401650
          *3/                                                                 S0401660
          *05X,54HWIND SPEED IN THIRD QUARTER OF CANOPY (WSIN34 (M/S)) =,F6.3S0401670
          */                                                                  S0401680
          *05X,52HWIND SPEED IN TOP QUARTER OF CANOPY (WSIN44 (M/S)) =,F6.3/ S0401690
          *05X,36HHEIGHT OF CANOPY (HGTCAN (METERS)) =,3(F6.2,1H,)/           S0401700
          *05X,37HPROBABILITY OF PENETRATION (PRBPEN) =,3(F5.3,1H,)/          S0401710
          *05X,36HTREE DENSITY (TREDEN (TREES/ACRE)) =,3(F7.2,1H,))           S0401720
      9021 FORMAT (05X,54HCOLLECTION EFFICIENCIES FOR DROP CATEGORIES (COLEFFS0401730
          *) =/(05X,10(F5.3,1H,)))                                            S0401740
      9022 FORMAT (05X,47HDIAMETER OF VEGETATIVE ELEMENTS (COLEFF (CM)) =,3(FS0401750
          *6.2,1H,))                                                          S0401760
      9023 FORMAT (05X,47HTREE WIDTH FROM BOTTOM TO TOP FOR FOREST CLASS ,I1,S0401770
          *15H (TREENV (M)) =/(05X,9(F6.3,1H,)))                              S0401780
      9024 FORMAT (10X,44H*** INPUTS USED BY THE DISPERSION MODELS ***)       S0401790
      9025 FORMAT (5X,33HNUMBER OF LINE SOURCES (NSOURC) =,I4/                S0401800
          *05X,52HNUMBER OF RECEPTORS IN GRID SYSTEM X AXIS (NXPNTS) =,I4/    S0401810
          *05X,52HNUMBER OF RECEPTORS IN GRID SYSTEM Y AXIS (NYPNTS) =,I4/    S0401820
          *05X,39HNUMBER OF DISCRETE RECEPTORS (NXYPNT) =,I4)                 S0401830
      9026 FORMAT (05X,43HEMISSION OF SPRAY MATERIAL (Q (GAL/ACRE)) =,E12.6/ S0401840
          *05X,42HDISTANCE BETWEEN SPRAY LINES (SWATH (M)) =,F9.3)            S0401850
      9027 FORMAT (05X,42HEMISSION OF SPRAY MATERIAL (Q (GRAMS/M)) =,E12.6)  S0401860
      9028 FORMAT (05X,49HHEIGHT OF DISPERSION MODELS CALCULATION (Z (M)) =,FS0401870
          *7.2/                                                               S0401880
          *05X,53HSTANDARD DEV. OF WIND DIRECTION ANGLE (SIGAP (RAD)) =,F7.5/S0401890
          *05X,53HSTANDARD DEV. OF WIND ELEVATION ANGLE (SIGEP (RAD)) =,F7.5/S0401900
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     *05X,47HTIME TO SPRAY CLOUD STABILIZATION (TAU (SEC)) =,F8.3/       S0401910
     *05X,41HMEASUREMENT TIME FOR SIGAP (TAUO (SEC)) =,F8.3/             S0401920
     *05X,61HSTAND. DEV. OF SPRAY MATERIAL ALONG SPRAY LINE (SIGXYZ (M))S0401930
     *)=,F8.3/                                                           S0401940
     *05X,34HDECAY COEFFICIENT (DECAY (/SEC)) =,E12.6)                   S0401950
 9029 FORMAT (05X,43HLAT., VERT. REFERENCE DISTANCE (XLRZ (M)) =,F9.3/   S0401960
     *05X,38HSURFACE MIXING LAYER HEIGHT (HM (M)) =,F9.3/                S0401970
     *05X,37HWIND DIRECTION (FROM) (THETA (DEG)) =,F7.2/                 S0401980
     *05X,55HAREA ASSIGNMENT FOR DISCRETE RECEPTORS (DAREA (M**2)) =,F12S0401990
     *.2/05X,53HRATIO OF LAGRANGIAN TO EULERIAN TIME SCALES (BETA1) =,F5S0402000
     *.2/05X,31HWIND-SPEED SHEAR (DELU (M/S)) =,F7.4)                    S0402010
 9030 FORMAT (05X,40HX AXIS OF RECEPTOR GRID SYSTEM (X (M)) =,2(F9.1,1H,S0402020
     *)/(05X,6(F9.1,1H,)))                                               S0402030
 9031 FORMAT (05X,40HY AXIS OF RECEPTOR GRID SYSTEM (Y (M)) =,2(F9.1,1H,S0402040
     *)/(05X,6(F9.1,1H,)))                                               S0402050
 9032 FORMAT (05X,30HX DISCRETE RECEPTORS (X (M)) =,3(F9.1,1H,)/(05X,6(FS0402060
     *9.1,1H,)))                                                         S0402070
 9033 FORMAT (05X,30HY DISCRETE RECEPTORS (Y (M)) = 3(F9.1,1H,)/(05X,6(FS0402080
     *9.1,1H,)))                                                         S0402090
 9034 FORMAT (05X,54HSTART AND END X COORDINATES OF LINE SOURCES (DX (M)S0402100
     *) =/(05X,6(F9.1,1H,)))                                             S0402110
 9035 FORMAT (05X,54HSTART AND END Y COORDINATES OF LINE SOURCES (DY (M)S0402120
     *) =/(05X,6(F9.1,1H,)))                                             S0402130
 9036 FORMAT (05X,56HFRACTION OF SPRAY MATERIAL FOR EACH DROP CAT. (PCTMS0402140
     *AT) =,F7.5,1H,/(05X,8(F7.5,1H,)))                                  S0402150
 9037 FORMAT (05X,60HSETTLING VEL. SPECIFYING WHICH SET OF GAMA, GAMB ANS0402160
     *D GAMC TO/05X,19HUSE (VSGAM (M S)) =,F7.4,1H,,F7.4)                S0402170
 9038 FORMAT (05X,74HCOEFFICIENTS OF EQUATIONS GIVING SURF. REFLECT. COES0402180
     *FFS. (GAMA,GAMB,GAMC) =/(05X,5(E12.6,1H,)))                        S0402190
 9039 FORMAT (05X,44HDOSAGE LEVELS FOR AREA-OF-COVERAGE (DOSLV) =,E12.6,S0402200
     *1H,/(05X,5(E12.6,1H,)))                                            S0402210
 9040 FORMAT (05X,51HCONCENTRATION LEVELS FOR AREA-OF-COVERAGE (CONLV) =S0402220
     *,E12.6,1H,/(05X,5(E12.6,1H,)))                                     S0402230
 9041 FORMAT (05X,48HDEPOSITION LEVELS FOR AREA-OF-COVERAGE (DEPLV) =,E1S0402240
     *2.6,1H,/(05X,5(E12.6,1H,)))                                        S0402250
      END                                                                S0402260
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      SUBROUTINE CBGS3                                                  S0500010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0500020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0500030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0500040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0500050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLY(10),   S0500060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0500070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0500080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0500090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0500100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0500110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0500120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0500130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S0500140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0500150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0500160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0500170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0500180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0500190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0500200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0500210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0500220
      INTEGER TITLE                                                     S0500230
C                                                                       S0500240
C                                                                       S0500250
C                                                                       S0500260
C     SET ABOVE CANOPY FLAG                                             S0500270
      IFUP = 1                                                          S0500280
C     GO CALC. PARAMETERS FOR EVAPORATION MODEL FOR ABOVE CANOPY        S0500290
      CALL EVPMD                                                        S0500300
C     GO CALC. EVAPORATION FOR ABOVE CANOPY                             S0500310
      CALL EVPML                                                        S0500320
C     SET FRACTION OF MATERIAL REACHING CANOPY AND DISTANCE TRAVEL      S0500330
C     THROUGH CANOPY TO 1 AND 0, RESPECTIVELY IN CASE THERE IS NO       S0500340
C     CANOPY. USED LATER IN DISPERSION MODELS.                          S0500350
      DO 10 J=1,20                                                      S0500360
      DO 10 I=1,11                                                      S0500370
      CNTD(I,J) = 1.0                                                   S0500380
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   10 DISTM(I,J) = 0.0                                           S0500390
C     IF NO CANOPY BRANCH                                        S0500400
      IF (ISW(3).LE. 0) GO TO 20                                 S0500410
C     SET BELOW CANOPY FLAG                                      S0500420
      IFUP = 2                                                   S0500430
C     GO CALC. PARAMETERS FOR BELOW CANOPY EVAPORATION           S0500440
      CALL EVPMD                                                 S0500450
C     GO CALC. BELOW CANOPY EVAPORATION                          S0500460
      CALL EVPML                                                 S0500470
C     GO CALC. CANOPY PENETRATION MODEL                          S0500480
      CALL CANPY                                                 S0500490
   20 CONTINUE                                                   S0500500
C     IF NO DISPERSION MODEL CALCS. BRANCH                       S0500510
      IF (ISW(4) .LE. 0) GO TO 40                                S0500520
C     GO CALC. DISPERSION MODELS                                 S0500530
   30 CONTINUE                                                   S0500540
      CALL CBGS4                                                 S0500550
      RETURN                                                     S0500560
   40 WRITE (IOTFIL,9001)                                        S0500570
      STOP                                                       S0500580
 9001 FORMAT (31H1***** END OF FSCBG PROG. *****/1H1)            S0500590
      END                                                        S0500600
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      SUBROUTINE EVPMD                                                  S0600010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0600020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0600030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0600040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0600050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0600060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0600070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0600080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0600090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0600100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0600110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0600120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0600130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S0600140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0600150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0600160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0600170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0600180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0600190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0600200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0600210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0600220
      INTEGER TITLE                                                     S0600230
      PRSVP(A,B) = B*(575.0466+A*(31.82291+1.296028*A))/(93.51611-A)    S0600240
C     SUBROUTINE USED TO CALCULATE PARAMETERS USED IN THE EVAPORATION   S0600250
C     MODEL AND USED TO CALCULATE THE WAKE SETTLING VELOCITY.           S0600260
      IF (IFUP .EQ. 1) T2 = AIRTPO                                      S0600270
C     IFUP = 1 IS ABOVE CANOPY                                          S0600280
C     IFUP = 2 IS BELOW CANOPY                                          S0600290
      IF (IFUP .EQ. 2) T2 = AIRTPU                                      S0600300
      IF (VAPINF .GE. 0.0) GO TO 10                                     S0600310
C     PARAMETERS THAT ARE DEFAULTED ARE SET NEGATIVE SO WHEN THE BELOW  S0600320
C     CANOPY PASS IS MADE THEY WILL BE RECALCULATED FOR BELOW CANOPY    S0600330
C     CONDITIONS.                                                       S0600340
C     APPROX. VAPINF BY THAT OF WATER                                   S0600350
      IF (IFUP .EQ. 1) VAPINF = -PRSVP(T2,0.01*RELHMO)                  S0600360
      IF (IFUP .EQ. 2) VAPINF = -PRSVP(T2,0.01*RELHMU)                  S0600370
   10 CONTINUE                                                          S0600380
```

```
      T2 = T2+273.16
      IF (AIRDEN .GT. 0.0) GO TO 20
C     CALC. AIR DENSITY
      AIRDEN = -(1.202744181E-5*AIRMOL*(AIRPRS-.37803*ABS(VAPINF))/T2)
   20 IF (CONMOL .GE. 0.0) GO TO 30
C     APPROX. MOLAL CONCENTRATION
      CONMOL = -ABS(AIRDEN)/AIRMOL
   30 CONTINUE
      IF (IFWATR .LE. 1) GO TO 110
C
C
C
C
C*********************************************************************
C     DROP LIQUID IS NOT WATER
C
C
C
C     USE AIR TEMP. AS INITIAL GUESS AT DROP TEMP.
      T3 = T2
      T4 = AIRPRS*.75006168
C     .75006168 IS 760/1013.25
      T9 = 213.79575/AIRPRS
C     213.79575 IS 0.211*1013.25
      T10 = ABS(VAPINF)*.75006168
      K = 1
C     START ITERATION LOOP
   40 DRPPRS = EXP(BCONST-CCONST/T3)
      IF (HETLAT .GT. 0.0) GO TO 50
C     APPROX. HETLAT BY THAT FOR WATER, SETTING NEG. FOR FLAG.
      HETLAT = -(597.3*(273.16/T3)**(0.107+3.67E-4*T3))*VAPMOL
   50 CONTINUE
      IF (DFUSIV .GT. 0.0) GO TO 60
C     APPROX. DFUSIV BY THAT FOR WATER, SETTING NEG. FOR FLAG.
      DFUSIV = -(T9*(3.6608581E-3*T3)**1.94)
   60 CONTINUE
      IF (THERMC .GT. 0.0) GO TO 70
C     APPROX. THERMC BY THAT FOR WATER, SETTING NEG. FOR FLAG.
```

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      T7 = T3-273.16                                                    S0600770
      T1 = 5.69E-5+1.7E-7*T7                                            S0600780
      T7 = 3.78E-5+2.0E-7*T7                                            S0600790
      THERMC = -(T1*(1.0-(1.17-1.02*T7/T1))*ABS(VAPINF)/AIRPRS)         S0600800
   70 CONTINUE                                                          S0600810
      T1 = ABS(THERMC/(CONMOL*DFUSIV*HETLAT))                           S0600820
      T7 = T1*(T2-T3)                                                   S0600830
      T6 = 1.0+T7                                                       S0600840
      T8 = DRPPRS*T6                                                    S0600850
      T7 = T8-T7*T4-T10                                                 S0600860
      T8 = T8*(CCONST/(T3*T3))+T1*(T4-DRPPRS)                           S0600870
      DRPTMP = T3-T7/T8                                                 S0600880
      K = K+1                                                           S0600890
      IF (K .GT. 1000) GO TO 90                                         S0600900
      IF (DRPTMP .GT. 0.0) GO TO 80                                     S0600910
      T3 = T3*.66666667                                                 S0600920
      GO TO 40                                                          S0600930
   80 IF (ABS(DRPTMP-T3) .LE. 0.01) GO TO 100                           S0600940
      T3 = DRPTMP                                                       S0600950
      GO TO 40                                                          S0600960
   90 CONTINUE                                                          S0600970
      WRITE (IOTFIL,9001)                                               S0600980
      DRPTMP = T2                                                       S0600990
      DRPPRS = EXP(BCONST-CCONST/T2)                                    S0601000
  100 DRPTMP = DRPTMP-273.16                                            S0601010
      DRPPRS = DRPPRS*1.33322368                                        S0601020
C     1.33322368 IS 1013.25/760                                         S0601030
      GO TO 170                                                         S0601040
C                                                                       S0601050
C*********************************************************************** S0601060
C     LIQUID IS WATER                                                   S0601070
C                                                                       S0601080
C                                                                       S0601090
C                                                                       S0601100
  110 K = 0                                                             S0601110
      T1 = 0.0                                                          S0601120
      IF (IFUP .EQ. 1) T2 = 0.01*RELHMO                                 S0601130
      IF (IFUP .EQ. 2) T2 = 0.01*RELHMU                                 S0601140
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```
      T12 = AIRTPO
      IF (IFUP .EQ. 2) T12 = AIRTPU
C     CALC. VAPOR PRESS. OF WATER AT INFINITY
      VAPINF = PRSVP(T12,T2)
      IF (AIRDEN .GT. 0.0) GO TO 120
      AIRDEN = -(1.202744181E-5*AIRMOL*(AIRPRS-.37803*VAPINF)/(T12+273.1
     *6))
C     CALC. INITIAL GUESS FOR DROP TEMP.
  120 T3 = 0.0
      IF (T2 .GT. 0.0) T3 = T12*T2**0.3
      T4 = 1.0/AIRPRS
      T5 = T3+273.16
      T6 = 213.79575*T4
C     213.79575 IS 1013.25*0.211
      T7 = 3.6608581E-3
C     3.6608581E-3 IS 1/273.16
      T4 = T4*VAPINF
      T8 = 1.20274418E-5*VAPMOL
C     1.20274418E-5 IS 1.0E-4/8.31432
      T9 = 0.25*T12
C     CALC. LATENT HEAT OF VAPORIZATION AT DROP TEMP.
  130 HETLAT = 597.3*(273.16/T5)**(0.107+3.67E-4*T5)
C     CALC. THE VAPOR PRESS. OF THE DROP AT THE DROP TEMP.
      DRPPRS = PRSVP(T3,1.0)
C     CALC. THE DIFFUSIVITY AT THE DROP TEMP.
      DFUSIV = T6*(T5*T7)**1.94
C     CALC. THE THERMAL CONDUCTIVITY OF AIR AT THE DROP TEMP.
      T10 = 5.69E-5+1.7E-7*T3
      T11 = 3.78E-5+2.0E-7*T3
      THERMC = T10*(1.0-(1.17-1.02*T11/T10)*T4)
C     CALC. THE INITIAL GUESS FOR T11 (AIRTMP-DRPTMP) USING T10, THE
C     AVERAGE OF THE DROP TEMP. AND AIR TEMP.
      T10 = 0.5*(T12+T3)+273.16
      T11 = HETLAT*DFUSIV*T8*(DRPPRS-VAPINF)/(THERMC*T10)
C     CALC. NEXT GUESS BY TAKING 1/4 OF THE NEW TO 3/4 OF THE OLD.
      T3 = T9-0.25*T11+0.75*T3
      T5 = T3+273.16
      IF (ABS(T3-T1) .LE. 0.001) GO TO 150
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      K = K+1                                                           S0601530
      IF (K .GT. 500) GO TO 140                                         S0601540
      T1 = T3                                                           S0601550
      GO TO 130                                                         S0601560
  140 WRITE (IOTFIL,9001)                                               S0601570
      DRPTMP = T12                                                      S0601580
      DRPPRS = PRSVP(T12,1.0)                                           S0601590
      GO TO 160                                                         S0601600
  150 DRPTMP = T3                                                       S0601610
  160 CONTINUE                                                          S0601620
C                                                                       S0601630
C                                                                       S0601640
C                                                                       S0601650
  170 CONTINUE                                                          S0601660
      IF (IFUP .EQ. 2) GO TO 180                                        S0601670
C                                                                       S0601680
C                                                                       S0601690
C                                                                       S0601700
C                                                                       S0601710
C*********************************************************************** S0601720
C     CALC. THE WAKE SETTLING VELOCITY, IF REQUIRED.                    S0601730
C                                                                       S0601740
C                                                                       S0601750
C                                                                       S0601760
C                                                                       S0601770
      IF (ISW(1) .NE. 0) WAKVEL = 2.52852E-3*ARCRWT/(ABS(AIRDEN)*ARCRSP*S0601780
     *WNGSPN*WNGSPN)                                                    S0601790
  180 CONTINUE                                                          S0601800
      T1 = AIRTPO                                                       S0601810
      IF (IFUP .EQ. 2) T1 = AIRTPU                                      S0601820
      T1 = T1+273.16                                                    S0601830
C     CALC. THE ABSOLUTE VISCOSITY OF AIR                               S0601840
      ABSVSC = 1.49628635E-5*T1**1.5/(T1+296.16)                        S0601850
C     PRE. CALC. EQUATION PARTS FOR EVAP MODEL                          S0601860
      T4 = ABSVSC/ABS(AIRDEN)                                           S0601870
C     CALC. THE SCHMIDT NUMBER                                          S0601880
      SCHMDT = T4/ABS(DFUSIV)                                           S0601890
      T5 = 1.0/ABSVSC                                                   S0601900
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      T3 = DENLIQ*T5                                                    S0601910
      T2 = 10453.3333*T3*ABS(AIRDEN)*T5                                 S0601920
      T3 = 217.77777*T3                                                 S0601930
      T4 = 0.5*T4                                                       S0601940
      T5 = 2.0*ABS(AIRDEN)*T5                                           S0601950
      T6 = SCHMDT**.33333333                                            S0601960
      IF (IFWATR .EQ. 2) T6 = T6*0.3                                    S0601970
      T8 = 4.188790206*DENLIQ                                           S0601980
      T9 = WNGSPN*0.5                                                   S0601990
      T10 = WAKVEL*100.0                                                S0602000
      T7 = VAPMOL*ABS(DFUSIV*AIRDEN)*(DRPPRS-ABS(VAPINF))/(AIRMOL*      S0602010
     *DENLIQ*(AIRPRS-DRPPRS))                                           S0602020
      IF (ISW(5) .LT. 1) GO TO 190                                      S0602030
      CALL IOPUT(1,2,IFUP)                                              S0602040
      T13 = ABS(VAPINF)                                                 S0602050
      T14 = ABS(CONMOL)                                                 S0602060
      T15 = ABS(THERMC)                                                 S0602070
      T16 = ABS(HETLAT)                                                 S0602080
      T17 = ABS(DFUSIV)                                                 S0602090
      T12 = ABS(AIRDEN)                                                 S0602100
      WRITE (IOTFIL,9002) T13,T12,T14,T17,T15,T16,DRPPRS,DRPTMP,        S0602110
     *WAKVEL                                                            S0602120
      WRITE (IOTFIL,9003) ABSVSC,SCHMDT                                 S0602130
      IF (ISW(5) .LT. 2) GO TO 190                                      S0602140
      WRITE (IOTFIL,9004) T1,T2,T3,T4,T5,T6,T7,T8,T9,T10                S0602150
  190 CONTINUE                                                          S0602160
      RETURN                                                            S0602170
 9001 FORMAT (63H *** WARNING - UNABLE TO CALC. DROP TEMP., PROG  USES AS0602180
     *IR TEMP.)                                                         S0602190
 9002 FORMAT (10X,38HVAPOR PRESSURE OF LIQUID AT INFINITY =,E14.8,5H (MBS0602200
     *)/10X,13HAIR DENSITY =,E14.8,10H (G/CM**3)/10X,43HMOLAL CONCENTRATS0602210
     *ION OF AIR-LIQUID MIXTURE =,E14.8,10H (G/CM**3)/10X,67HDIFFUSIVITYS0602220
     * OF EVAPORATING VAPOR INTO AIR AT THE DROP TEMPERATURE =,E14.8,12HS0602230
     * (CM**2/SEC)/10X,68HTHERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT S0602240
     *THE DROP TEMPERATURE =,E14.8,24H (CAL/(SEC CM.DEGREE K))/10X,53HLAS0602250
     *TENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE =,E14.8,11H (CALS0602260
     */MOLE)/10X,15HDROP PRESSURE =,E14.8,5H (MB)/10X,19HDROP TEMPERATURS0602270
     *E =,E14.8,12H (DEGREES C)/10X,24HWAKE SETTLING VELOCITY =,E14.8,6HS0602280
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     * (M/S))
9003 FORMAT (10X,32HABSOLUTE VISCOSITY (GM/CM/SEC) =,E14.8/
    *10X,16HSCHMIDT NUMBER =,E14.8)
9004 FORMAT (39H DIAG - T1,T2,T3,T4,T5,T6,T7,T8,T9,T10=,5E14.8/(1X,
    *9E14.8))
      END
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      SUBROUTINE EVPML                                                  S0700010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0700020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0700030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0700040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0700050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0700060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0700070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0700080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0700090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0700100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0700110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0700120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0700130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S0700140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0700150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0700160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0700170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0700180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0700190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0700200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0700210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0700220
      DIMENSION DRPTP(100),DRPBP(100),TMLSP(100),TMSS(100),TIMT(100)    S0700230
      INTEGER TITLE                                                     S0700240
C     EVAPORATION MODEL PROGRAM. THIS SUBROUTINE LOOPS OVER EACH DROP   S0700250
C     SIZE CATEGORY, CALCULATING THE EVAPORATION RATE AND ALL RELATED   S0700260
C     INFORMATION REQUIRED BY THE CANOPY PENETRATION MODEL AND THE      S0700270
C     DISPERSION MODELS.                                                S0700280
C                                                                       S0700290
C     BEGIN LOOP OVER DROP SIZE CATEGORIES                              S0700300
      IA = 1H1                                                          S0700310
      DO 650 K=1,NVS                                                    S0700320
      FCT = 1.0                                                         S0700330
C     FCT IS A MULTIPLIER ON DELTA-H THE ITERATION HEIGHT INTERVAL. IF  S0700340
C     THE DELTA-H USED DOES NOT PROVIDE ENOUGH POINTS FOR AN ACCURATE   S0700350
C     REGRESSION ANALYSIS THE VALUE OF FCT IS CHANGED TO PROVIDE MORE   S0700360
C     POINTS AND THE PROGRAM REPEATS THE ITERATION.                     S0700370
      GO TO 20                                                          S0700380
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   10 FCT = FCT*0.5                                                     S0700390
   20 CONTINUE                                                          S0700400
      IF (ISW(5) .GE. 2) WRITE (IOTFIL,9001) IA,K,FCT,IFUP,             S0700410
     *HGTCFT                                                            S0700420
      IA = 1H                                                           S0700430
      N = 0                                                             S0700440
C     SUBROUTINE CONTROL FLAGS                                          S0700450
      IF1 = 0                                                           S0700460
      IF2 = 0                                                           S0700470
      IF3 = 0                                                           S0700480
      IF4 = 0                                                           S0700490
      IF5 = 0                                                           S0700500
      IF6 = 0                                                           S0700510
      DRPTOL = 0.0                                                      S0700520
      DRPBOL = 0.0                                                      S0700530
      LINE = 57                                                         S0700540
      M = 0                                                             S0700550
C     CONVERT DROP SIZE TO RADIUS IN CM                                 S0700560
      RD(1) = DRPUPR(K)*5.0E-5                                          S0700570
      RD(2) = DRPLWR(K)*5.0E-5                                          S0700580
      TMLS = 0.0                                                        S0700590
C     IF BELOW CANOPY BRANCH                                            S0700600
      IF (IFUP .EQ. 2) GO TO 30                                         S0700610
C     SET ABOVE CANOPY PARAMETERS                                       S0700620
      RELHM = RELHMO                                                    S0700630
C     XLOC IS HORIZONTAL TRAVEL DISTANCE                                S0700640
      XLOC = 0.0                                                        S0700650
C     TIME IS TIME OF TRAVEL                                            S0700660
      TIME = 0.0                                                        S0700670
C     TMLST IS TOTAL MASS LOST DUE TO EVAPORATION                       S0700680
      TMLST = 0.0                                                       S0700690
C     HI IS THE HEIGHT OF THE DROP                                      S0700700
      HI = HGTCFT                                                       S0700710
C     XLOCS IS AN ARRAY IN WHICH THE DISTANCE OF THE DROP TO THE POINT  S0700720
C     THE DROP ENTERS THE CANOPY IS SAVED FOR DROP SIZE CATEGORY K.     S0700730
      XLOCS(K) = 0.0                                                    S0700740
C     VSSS IS AN ARRAY IN WHICH THE SETTLING VELOCITY OF THE DROP AS THES0700750
C     DROP ENTERS THE CANOPY IS SAVED                                   S0700760
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      VSSS(K) = 0.0                                                     S0700770
C     TIMO IS AN ARRAY IN WHICH THE TIME OF TRAVEL IS SAVED WHEN ISW(2) S0700780
C     = 2. TIMO IS TIME USED WHEN THE USER HAS SPECIFIED THE RATE OF    S0700790
C     EVAPORATION VIA DAU, DBU, DCU, DAL, DBL AND DCL.                  S0700800
      TIMO(K) = 0.0                                                     S0700810
C     TMLSO IS AN ARRAY IN WHICH THE FRACTION OF MATERIAL REACHING THE  S0700820
C     CANOPY HEIGHT IS SAVE FOR DROP CATEGORY K.                        S0700830
      TMLSO(K) = 0.0                                                    S0700840
      GO TO 90                                                          S0700850
C     SET PARAMETERS FOR BELOW CANOPY EVAPORATION                       S0700860
C     SET DISTANCE OF DROP TRAVEL TO TOP OF CANOPY                      S0700870
   30 XLOC = XLOCS(K)                                                   S0700880
      RELHM = RELHMU                                                    S0700890
C     SET TIME TO TOP OF CANOPY                                         S0700900
      TIME = TIMO(K)                                                    S0700910
C     SET FRACTION OF MATERIAL REACHING TOP OF CANOPY                   S0700920
      TMLST = TMLSO(K)                                                  S0700930
C     SET HEIGHT TO TOP OF CANOPY                                       S0700940
      HI = HGTCAN(1)                                                    S0700950
C     CHECK TO SEE IF USER HAS SPECIFIED EVAPORATION RATE               S0700960
      IF (ISW(2) .NE. 2) GO TO 90                                       S0700970
C     USER HAS SPECIFIED EVAPORATION RATE                               S0700980
C     USER HAS INPUT DROP VS. TIME FUNCTION                             S0700990
C     SOLVE FOR TIME FOR DROP SIZE AT TOP OF CANOPY                     S0701000
      IF (DCL(K)) 40,50,40                                              S0701010
   40 T16 = DBL(K)*DBL(K)-4.0*(DAL(K)-DRPUPR(K))*DCL(K)                 S0701020
      IF (T16 .LT. 0.0) T16 = 0.0                                       S0701030
C     TIML IS TIME FOR BELOW CANOPY WHEN USER INPUTS DROP VS. TIME      S0701040
C     EQUATIONS                                                         S0701050
      TIML = (-DBL(K)-SQRT(T16))/(2.0*DCL(K))                           S0701060
      GO TO 80                                                          S0701070
   50 IF (DBL(K)) 60,70,60                                              S0701080
   60 TIML = (DRPUPR(K)-DAL(K))/DBL(K)                                  S0701090
      GO TO 80                                                          S0701100
   70 TIML = 0.0                                                        S0701110
   80 CONTINUE                                                          S0701120
   90 CONTINUE                                                          S0701130
      HLAST = HI                                                        S0701140
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      IF (ISW(2) .EQ. 2) GO TO 100                                      S0701150
C     CALC. THE AVERAGE DROP RADIUS USING GEOMETRIC MEAN.               S0701160
      RD(3) = AVGRD(RD(1),RD(2))                                        S0701170
      GO TO 130                                                         S0701180
  100 IF (IFUP .EQ. 2) GO TO 110                                        S0701190
C     ABOVE CANOPY - USER HAS INPUT DROP VS. TIME                       S0701200
      DRPUPR(K) = DAU(K)+TIME*(DBU(K)+TIME*DCU(K))                      S0701210
      GO TO 120                                                         S0701220
C     BELOW CANOPY - USER HAS INPUT DROP VS. TIME                       S0701230
  110 DRPUPR(K) = DAL(K)+TIML*(DBL(K)+TIML*DCL(K))                      S0701240
  120 DRPLWR(K) = DRPUPR(K)                                             S0701250
      RD(1) = DRPUPR(K)*5.0E-5                                          S0701260
      RD(2) = RD(1)                                                     S0701270
      RD(3) = RD(1)                                                     S0701280
  130 CONTINUE                                                          S0701290
      IF (DRPUPR(K) .LE. 0.0) GO TO 540                                 S0701300
C     CALC. DELTA H                                                     S0701310
      DELTH = HI*0.0166666*FCT                                          S0701320
      DELTAH = DELTH                                                    S0701330
      IF (IFUP .EQ. 2) GO TO 140                                        S0701340
C     SAVE THE AVERAGE DROP SIZE AT THE TOP FOR LATER USE WITH BELOW    S0701350
C     CANOPY EVAP.                                                      S0701360
      RDST(K) = RD(3)                                                   S0701370
  140 CONTINUE                                                          S0701380
C     RDSTI IS COSTANT USED IN CALCULATION OF FRACTION OF MATERIAL      S0701390
C     REACHING HEIGHT. THE FRACTION IS CALCULATED BY THE DROP VOLUME    S0701400
C     NOW DIVIDED BY THE ORIGINAL DROP VOLUME.                          S0701410
      RDSTI = 1.0/(RDST(K)*RDST(K)*RDST(K))                             S0701420
      N = 1                                                             S0701430
C     N IS THE NUMBER OF ITERATIVE POINTS SAVED                         S0701440
C     SAVE UPPER DIAMETER IN MICROMETERS                                S0701450
      DRPTP(N) = RD(1)*2.0E4                                            S0701460
C     SAVE LOWER DIAMETER IN MICROMETERS                                S0701470
      DRPBP(N) = RD(2)*2.0E4                                            S0701480
C     SAVE MEAN DIAMETER IN MICROMETERS                                 S0701490
      DRPDM(N) = RD(3)*2.0E4                                            S0701500
C     SAVE PERCENTAGE OF MATERIAL                                       S0701510
      TMSLO(N) = 100.0*RD(3)*RD(3)*RD(3)*RDSTI                          S0701520
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C     SAVE HEIGHT
      HIO(N) = HI
C     SAVE DISTANCE
      XDO(N) = XLOC
C     SAVE TOTAL MASS LOST
      TMLSP(N) = TMLST
C     SAVE MASS LOST IN HEIGHT INTERVAL
      TMSS(N) = 0.0
C     SAVE TIME
      TIMT(N) = TIME
C     SET NEW DROP RADIUS TO OLD DROP RADIUS
      RDN(1) = RD(1)
      RDN(2) = RD(2)
      RDN(3) = RD(3)
C     GO CALCULATE DROP SETTLING VELOCITY IN CM/SEC
      CALL TRMVL
C     SET SETTLING VELOCITY OF MEAN DROP (M/S)
      VSSO(N) = VSI(3)*0.01
  150 CONTINUE
  160 CONTINUE
C     BRANCH IF USER SPECIFIED EVAP. RATE
      IF (ISW(2) .EQ. 2) GO TO 270
C     CALC. REYNOLDS NUMBER FOR UPPER AND LOWER DROP SIZES
      DO 170 I=1,2
  170 RN(I) = T5*VSI(I)*RD(I)
C     CALC. SHERWOOD NUMBERS
C     BRANCH IF NOT WATER
      IF (IFWATR .EQ. 2) GO TO 200
C     SHERWOOD NUMBERS FOR WATER, DEVELOPED FROM EXPERIMENTS OF
C     PRUPPACHER AND RASMUSSEN (1979)
      DO 190 I=1,2
      T16 = T6*SQRT(RN(I))
      IF (T16 .GT. 1.4) GO TO 180
      FV(I) = 1.0+0.108*T16
      GO TO 190
  180 FV(I) = 0.78+0.308*T16
  190 CONTINUE
      GO TO 220
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C     SHERWOOD NUMBERS FOR NON-WATER
  200 DO 210 I=1,2
  210 FV(I) = 1.0+T6*SQRT(RN(I))
  220 CONTINUE
C     CALC. RATE OF CHANGE OF DROP RADIUS WITH TIME (T16)
      DO 260 I=1,2
      T16 = T7*FV(I)/RD(I)
C     ADJUST TIME INCREMENT SO THAT (DRDT)*DT IS LESS THAN OR EQUAL TO
C     0.2% OF THE DROP RADIUS. FOR THIS DETERMINATION THE AVERAGE DROP
C     RADIUS AT THE BEGINNING OF THE TIME STEP WILL BE USED.
C
C     IF6 IS FLAG TO FORCE AT LEAST ONE OF THE CALCULATION HEIGHTS TO
C     BE EQUAL TO HGTCAN(1).
      IF (I .GT. 1.OR.IF6 .EQ. 1) GO TO 250
C     ONLY SET DT FROM THE FIRST CALC. OR DR/DT
      DT = 2.0E-3*RD(3)/T16
      IF (DT .LT. 0.02) DT = 0.02
      IF (IF4.NE.0.OR.IFUP.EQ.2.OR.WNGSPN.LE.0.0) GO TO 230
      IF (T9 .GE. HI-HGTCAN(1)) GO TO 230
      IF (IF5 .NE. 0.OR.T10 .GT. VSI(3)) GO TO 240
  230 IF (VSI(3)*0.01*DT .GT. DELTAH) DT = DELTAH/(0.01*VSI(3))
      GO TO 250
  240 IF (WAKVEL*DT .GE. DELTAH) DT = DELTAH/WAKVEL
C     CALC. NEW DROP RADIUS
  250 T16 = T16*DT
C     IF NO EVAPORATION
      IF (ISW(2) .EQ. 0) T16 = 0.0
      RDN(I) = RD(I)-T16
  260 CONTINUE
      GO TO 310
  270 DT = DELTAH/(0.01*VSI(3))
  280 IF (IFUP .EQ. 2) GO TO 290
C     ABOVE CANOPY
      RDN(1) = (DAU(K)+(TIME+DT)*(DBU(K)+(TIME+DT)*DCU(K)))*5.0E-5
      GO TO 300
C     BELOW CANOPY
  290 RDN(1) = (DAL(K)+(TIML+DT)*(DBL(K)+(TIML+DT)*DCL(K)))*5.0E-5
  300 RDN(2) = RDN(1)
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      RDN(3) = RDN(1)
  310 CONTINUE
      IF (RDN(2) .GT. 1.0E-4) GO TO 320
      IF3 = 1
      RDN(2) = 1.0E-4
  320 CONTINUE
      IF (ISW(2) .EQ. 2) GO TO 330
C     CALC. NEW AVERAGE RADIUS OF DROP
      RDN(3) = AVGRD(RDN(1),RDN(2))
C     CALC. THE MASS LOST FROM THE AVERAGE DROP
  330 T16 = T8*(RD(3)*RD(3)*RD(3)-RDN(3)*RDN(3)*RDN(3))
C     INCREMENT THE TOTAL MASS LOST
      TMLST = TMLST+T16
C     INCREMENT THE MASS LOST IN DELTA-H
      TMLS = TMLS+T16
C     CALC. THE NEW HEIGHT OF THE DROP LOCATION AND INCREMENT TIME
      IF (IF6 .EQ. 1) GO TO 370
      IF (IF4 .NE. 0) GO TO 340
      IF (IFUP .EQ. 2) GO TO 340
      IF(WNGSPN .LE. 0.0) GO TO 340
C     WHEN WNGSPN IS ZERO WE ASSUME NO WING VORTEX IS FORMED
      T17 = HI-HGTCAN(1)
C     WHEN THE WING TIP VORTEX TOUCHES THE CANOPY IT BREAKS UP AND DROPS
C     FALL AT VSI. T9 IS WNGSPN/2.0.
      IF (T9 .GE. T17) GO TO 340
C     IF WAKVEL IS GREATER THAN VSI, IT WILL ALWAYS BE GREATER.
      IF (IF5 .NE. 0) GO TO 360
      IF (T10 .GT. VSI(3)) GO TO 350
C     T10 IS 100*WAKVEL, THE FACTOR 100 CONVERTS WAKVEL INTO CM/SEC.
C     THE FIRST TIME THROUGH IF WAKVEL IS NOT GREATER THAN VSI, WE WANT
C     TO SET IF4 TO 1 SO THAT WE FALL OUT OF THE VORTEX. OTHERWISE THERE
C     WOULD BE A TIME WHEN VSI WOULD DECREASE BELOW WAKVEL, BUT BY THEN
C     THE DROPS ARE NO LONGER IN THE VORTEX.
      IF4 = 1
  340 DZ = 0.01*VSI(3)*DT
C     FACTOR OF 0.01 CONVERTS VSI TO MPS.
      GO TO 370
C     WHEN THE DROPS ARE IN A WING TIP VORTEX WHICH HAS A FALL VELOCITY
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C     WAKVEL GREATER THAN THE DROP TERMINAL VELOCITY, THE DROPS FALL AT S0702570
C     THE VORTEX VELOCITY. IF WAKVEL IS LESS THAN VSI, THE DROPS FALL   S0702580
C     OUT OF THE VORTEX AND FALL AT VSI.                                S0702590
  350 IF5 = 1                                                           S0702700
  360 DZ = WAKVEL*DT                                                    S0702710
  370 CONTINUE                                                          S0702720
      IF (IFUP .EQ. 2.OR.IF6 .NE. 0) GO TO 390                          S0702730
C     FIND POINT WHERE HEIGHT IS AT OR NEAR CANOPY HEIGHT SO WE CAN     S0702740
C     CALCULATE PARAMETERS FOR THE CANOPY HEIGHT.                       S0702750
      IF (HI-DZ .GT. HGTCAN(1)+.1.OR.HGTCAN(1) .LE. 0.0) GO TO 390      S0702760
C     AT OR NEAR CANOPY HEIGHT                                          S0702770
      T15 = HI-DZ                                                       S0702780
C     IF AT CANOPY HEIGHT BRANCH                                        S0702790
      IF (HGTCAN(1)-.1.LE.T15.AND.T15.LE.HGTCAN(1)+.1) GO TO 380        S0702800
C     WE HAVE GONE TOO FAR, MUST RECALCULATE DZ AND DT TO END UP AT     S0702810
C     CANOPY HEIGHT.                                                    S0702820
      DZ = HI-HGTCAN(1)                                                 S0702830
      DT = DZ/(0.01*VSI(3))                                             S0702840
C     SET FLAG TO INDICATE WE ARE RESETTING DZ, DT                      S0702850
      IF6 = 1                                                           S0702860
      TMLST = TMLST-T16                                                 S0702870
      TMLS = TMLS-T16                                                   S0702880
      IF (ISW(2) .EQ. 2) GO TO 280                                      S0702890
      IF (IF5 .EQ. 1) DT = DZ/WAKVEL                                    S0702900
      GO TO 220                                                         S0702910
  380 IF6 = 1                                                           S0702920
  390 CONTINUE                                                          S0702930
C     INCREMENT TIME                                                    S0702940
      TIME = TIME+DT                                                    S0702950
      IF (IFUP .EQ. 2) TIML = TIML+DT                                   S0702960
C     CALC. THE MIDPOINT OF THE HEIGHT OF THE LAST INTERVAL.            S0702970
      HMID = HI-0.5*DZ                                                  S0702980
C     CALC. NEW DROP HEIGHT                                             S0702990
      HI = HI-DZ                                                        S0703000
C     DETERMINE WIND SPEED                                              S0703010
      IF (IFUP .EQ. 2) GO TO 400                                        S0703020
C     USE WIND SPEED ABOVE CANOPY                                       S0703030
      UBAR = WSOCAN                                                     S0703040
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      GO TO 450                                                         S0703350
C     USE WIND SPEED WITHIN CANOPY                                      S0703360
  400 IF (HI .GE. 0.75*HGTCAN(1)) GO TO 430                             S0703070
      IF (HI .GE. 0.50*HGTCAN(1)) GO TO 420                             S0703080
      IF (HI .GE. 0.25*HGTCAN(1)) GO TO 410                             S0703090
      UBAR = WSIN14                                                     S0703100
      GO TO 440                                                         S0703110
  410 UBAR = WSIN24                                                     S0703120
      GO TO 440                                                         S0703130
  420 UBAR = WSIN34                                                     S0703140
      GO TO 440                                                         S0703150
  430 UBAR = WSIN44                                                     S0703160
  440 IF (UBAR .LE. 0.0) UBAR = WSOCAN                                  S0703170
  450 IF (UBAR .LE. 0.0) UBAR = 1.0E-6                                  S0703180
C     CALC. ANGLE OF DROP TRAJECTORY WITH HORIZONTAL                    S0703190
      ANG = 57.295779*ATAN(0.01*VSI(3)/UBAR)                            S0703200
C     DETERMINE HORIZONTAL POSITION OF DROP                             S0703210
      IF (HI .LT. -10000.0) IF2 = 1                                     S0703211
      XLOC = XLOC+UBAR*DT                                               S0703220
C     CALC DROP SETTLING VELOCITY                                       S0703230
      CALL TRMVL                                                        S0703240
C     WHEN THE DROP IS SMALL ENOUGH THAT THE SIZE IS LESS THAN 5 MICRO- S0703250
C     METERS WE ASSUME THIS IS VAPOR AND STOP THE CALCULATIONS          S0703260
  460 IF (HLAST-HI .GE. DELTAH-.001.OR.IF6 .EQ. 1) IF1 = 1              S0703270
      IF (RDN(3).LE.2.5E-4.OR.VSI(3).LE.0.02) IF2 = 1                   S0703280
      IF (IFUP .EQ. 2.AND.HI .LT. 0.0) IF2 = 1                          S0703290
      IF (ISW(2) .EQ. 0.AND.HI .LT. 0.0) IF2 = 1                        S0703300
      IF (ISW(2) .EQ. 1.AND.RELHM .GE. 099.0.AND.HI .LT. 0.0) IF2 = 1   S0703310
      DRPTO = RDN(1)*2.0E4                                              S0703320
      DRPBO = RDN(2)*2.0E4                                              S0703330
      DRPDI = RDN(3)*2.0E4                                              S0703340
      VST = VSI(3)*0.01                                                 S0703350
      IF (IF1 .EQ. 0.AND.IF2 .EQ. 0) GO TO 470                          S0703360
C     INCREMENT COUNTER AND SET PARAMETERS TO NEXT ITERATIVE VALUE      S0703370
      N = N+1                                                           S0703380
      DRPDM(N) = DRPDI                                                  S0703390
      TMSLO(N) = 100.0*RDN(3)*RDN(3)*RDN(3)*RDSTI                       S0703400
      HIO(N) = HI                                                       S0703410
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      XDO(N) = XLOC
      VSSO(N) = VST
      DRPTP(N) = DRPTO
      DRPBP(N) = DRPBO
      TMLSP(N) = TMLST
      TMSS(N) = TMLS
      TMLS = 0.0
      TIMT(N) = TIME
      IF (M .EQ. 0.AND.HI .LE. 0.0) M = N
  470 CONTINUE
      IF (IF6 .NE. 1.OR.IFUP .EQ. 2.OR.HGTCAN(1) .LE. 0.0) GO TO 480
      IF6 = 2
C     SAVE PARAMETERS AT CANOPY HEIGHT FOR LATER BELOW CANOPY CALCS.
      DRPTOL = DRPTO
      DRPBOL = DRPBO
      XLOCS(K) = XLOC
      TIMO(K) = TIME
      TMLSO(K) = TMLST
      VSSS(K) = VST
  480 CONTINUE
  490 IF (IF2 .NE. 0) GO TO 530
      IF (N .LT. 100) GO TO 520
      IF (ISW(2) .EQ. 0) GO TO 540
C     TOO MANY POINTS. HAVE NOT EVAPORATED DROP YET, MUST MAKE ROOM FOR
C     MORE POINTS. USE EVERY OTHER POINT FROM 75 TO 100.
      IF (M .LE. 0) M = 75
      I = M
      J = M
  500 I = I+2
      IF (I .GT. N) GO TO 510
      J = J+1
      DRPDM(J) = DRPDM(I)
      TMSLO(J) = TMSLO(I)
      HIO(J) = HIO(I)
      XDO(J) = XDO(I)
      VSSO(J) = VSSO(I)
      DRPTP(J) = DRPTP(I)
      DRPBP(J) = DRPBP(I)
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      TMLSP(J) = TMLSP(I)                                               S0703800
      TMSS(J) = TMSS(I)+TMSS(I-1)+TMSS(I-2)                             S0703810
      TIMT(J) = TIMT(I)                                                 S0703820
      GO TO 500                                                         S0703830
  510 N = J                                                             S0703840
      IF (M .LT. 98) M = M+1                                            S0703850
      DELTH = DELTH*2.0                                                 S0703860
C     ADJUST DELTH FOR LARGER DECREMENTS IN HEIGHT                      S0703870
      IF (ISW(5) .GE. 2) WRITE (IOTFIL,9002) N,M,DELTH                  S0703880
  520 CONTINUE                                                          S0703890
C     SET PARAMETERS FOR NEXT ITERATION                                 S0703900
      RD(1) = RDN(1)                                                    S0703910
      RD(2) = RDN(2)                                                    S0703920
      RD(3) = RDN(3)                                                    S0703930
C     GO TO NEXT ITERATION                                              S0703940
      IF (IF1 .EQ. 0) GO TO 150                                         S0703950
      HLAST = HI                                                        S0703960
      IF1 = 0                                                           S0703970
      IF (HI .LT. 0.0) DELTH = DELTH*1.2                                S0703980
      DELTAH = DELTH                                                    S0703990
C     GO TO NEXT ITERATION                                              S0704000
      GO TO 150                                                         S0704010
C     IF NOT ENOUGH POINTS GO CHANGE FCT AND REPEAT ITERATIONS          S0704020
  530 IF (N .LT. 50) GO TO 10                                           S0704030
  540 CONTINUE                                                          S0704040
C     ITERATIONS COMPLETE                                               S0704050
      IF (ISW(5) .LT. 1) GO TO 570                                      S0704060
C     PRINT CALCULATED PARAMETERS                                       S0704070
      DO 550 I=1,N                                                      S0704080
      CALL IOPUT(2,2,IFUP)                                              S0704090
      IF (N .LE. 0) GO TO 560                                           S0704100
      WRITE (IOTFIL,9003) HIO(I),DRPTP(I),DRPDM(I),DRPBP(I),TMLSP(I),   S0704110
     *TMSS(I),TIMT(I),XDO(I),VSSO(I),TMSLO(I)                           S0704120
  550 CONTINUE                                                          S0704130
      GO TO 570                                                         S0704140
  560 WRITE (IOTFIL,9004)                                               S0704150
  570 CONTINUE                                                          S0704160
      N = N-1                                                           S0704170
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      IF (N .LE. 0) GO TO 590
C     THE FIRST AND LAST POINTS OF EACH PARAMETER ARRAY ARE REMOVED
      DO 580 I=1,N
      DRPDM(I) = DRPDM(I+1)
      TMSLO(I) = TMSLO(I+1)*0.01
      HIO(I) = HIO(I+1)
      XDO(I) = XDO(I+1)
      VSSO(I) = VSSO(I+1)
      TIMT(I) = TIMT(I+1)
  580 CONTINUE
      N = N-1
  590 CONTINUE
      IF (IFUP .EQ. 2) GO TO 620
C     CALCULATE THE EQUATIONS DESCRIBING THE EVAPORATION VIA REGRESSION
C     FOR ABOVE CANOPY PARAMETERS.
      IF (N .LE. 0) GO TO 600
C     CALCULATE THE COEFFICIENTS OF VSSO VERSUS DISTANCE
      CALL REGRS(N,XDO,VSSO,A1(K),B1(K),C1(K),ISW(2))
C     CALCULATE THE COEFFICIENTS OF HEIGHT VERSUS DISTANCE
      CALL REGRS(N,XDO,HIO,A2(K),B2(K),C2(K),ISW(2))
C     CALCULATE THE COEFFICIENTS OF HEIGHT VERSUS FRACTION OF DROPS
      CALL REGRS(N,HIO,TMSLO,A3(K),B3(K),C3(K),ISW(2))
C     CALCULATE THE COEFFICIENTS OF TIME VERSUS HEIGHT
      CALL REGRS(N,HIO,TIMT,A4(K),B4(K),C4(K),ISW(2))
  600 IF (ISW(5) .LT. 1) GO TO 610
C     CALC COEFFICIENTS OF DROP VS. TIME EQUATION
      CALL REGRS(N,TIMT,DRPDM,T15,T16,T17,ISW(2))
      LINE = 57
      CALL IOPUT(3,2,IFUP)
      WRITE (IOTFIL,9005) A1(K),B1(K),C1(K),A2(K),B2(K),C2(K),
     *A3(K),B3(K),C3(K),A4(K),B4(K),C4(K),T15,T16,T17
C     SET UPPER AND LOWER DROP SIZES FOR BELOW CANOPY CALCS.
  610 DRPLWR(K) = DRPBOL
      DRPUPR(K) = DRPTOL
      IF (ISW(5) .LT. 2) GO TO 650
C     DETAIL OF ACCURACY OF REGRESSION
      CALL TEST(TIMT)
      GO TO 650
```

```
C     BELOW CANOPY EQUATIONS                                              S0704560
  620 CONTINUE                                                            S0704570
      IF (N .LE. 0) GO TO 640                                             S0704580
      HI = XDO(1)                                                         S0704590
      HLAST = 1.0/TMSLO(1)                                                S0704600
      DO 630 I=1,N                                                        S0704610
      XDO(I) = XDO(I)-HI                                                  S0704620
  630 TMSLO(I) = TMSLO(I)*HLAST                                           S0704630
C     CALC. COEFFICIENTS OF VSSO VERSUS HEIGHT                            S0704640
      CALL REGRS(N,HIO,VSSO,A10(K),B10(K),C10(K),ISW(2))                  S0704650
C     CALC. COEFFICIENTS OF HEIGHT VERSUS DISTANCE                        S0704660
      CALL REGRS(N,XDO,HIO,A11(K),B11(K),C11(K),ISW(2))                   S0704670
C     CALC. COEFFICIENTS OF DISTANCE VERSUS HEIGHT                        S0704680
      CALL REGRS(N,HIO,XDO,A12(K),B12(K),C12(K),ISW(2))                   S0704690
C     CALC. COEFFICIENTS OF HEIGHT VERSUS FRACTION OF DROPS               S0704700
      CALL REGRS(N,HIO,TMSLO,A13(K),B13(K),C13(K),ISW(2))                 S0704710
C     CALC. COEFFICIENTS HEIGHT VERSUS DROP SIZE                          S0704720
      CALL REGRS(N,HIO,DRPDM,A14(K),B14(K),C14(K),ISW(2))                 S0704730
  640 IF (ISW(5) .LT. 1) GO TO 650                                        S0704740
C CALC COEFFICIENTS OF DROP SIZE VS. TIME                                 S0704750
      CALL REGRS(N,TIMT,DRPDM,T15,T16,T17,ISW(2))                         S0704760
      LINE = 57                                                           S0704770
      CALL IOPUT(3,2,IFUP)                                                S0704780
      WRITE (IOTFIL,9006) A10(K),B10(K),C10(K),A11(K),B11(K),C11(K),      S0704790
     *A12(K),B12(K),C12(K),A13(K),B13(K),C13(K),A14(K),B14(K),C14(K),     S0704800
     *T15,T16,T17                                                         S0704810
      IF (ISW(5) .LT. 2) GO TO 650                                        S0704820
      CALL TEST(TIMT)                                                     S0704830
  650 CONTINUE                                                            S0704840
  660 CONTINUE                                                            S0704850
      RETURN                                                              S0704860
 9001 FORMAT (A1,15HBEGIN EVAP LOOP,I3,17H FCT,IFUP,HGTCFT=,E14.8,I4,E14S0704870
     *.8)                                                                 S0704880
 9002 FORMAT (26H TOO MANY PNTS, N,M,DELTH=,2I6,E14.8)                    S0704890
 9003 FORMAT (14X,F11.3,1X,3F9.3,2E11.4,F9.3,F9.2,F10.7,F9.3)             S0704900
 9004 FORMAT (51X,28H* NO DATA, DROP EVAPORATED *)                        S0704910
 9005 FORMAT (44X,43HSETTLING VELOCITY AS A FUNCTION OF DISTANCE/         S0704920
     *33X,10HVS(MPS) = ,E14.8,3H + ,E14.8,5H *X+ ,E14.8,6H *X**2//        S0704930
```

```
     *50X,32HHEIGHT AS A FUNCTION OF DISTANCE/                          S0704940
     *34X,7HH(M) = ,E14.8,3H + ,E14.8,5H *X+ ,E14.8,6H *X**2//          S0704950
     *34X,64HFRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HS0704960
     *EIGHT/                                                            S0704970
     *34X,8HFRACT = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2//         S0704980
     *52X,28HTIME AS A FUNCTION OF HEIGHT/                              S0704990
     *32X,12HTIME(SEC) = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2//    S0705000
     *48X,35HDROP DIAMETER AS A FUNCTION OF TIME/                       S0705010
     *25X,16HDROP(MICRO-M) = ,E14.8,3H + ,E14.8,5H *T+ ,E14.8,6H *T**2) S0705020
 9006 FORMAT (45X,41HSETTLING VELOCITY AS A FUNCTION OF HEIGHT/         S0705030
     *32X,10HVS(MPS) = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2//      S0705040
     *50X,32HHEIGHT AS A FUNCTION OF DISTANCE/                          S0705050
     *34X,7HH(M) = ,E14.8,3H + ,E14.8,5H *X+ ,E14.8,6H *X**2//          S0705060
     *50X,32HDISTANCE AS A FUNCTION OF HEIGHT/                          S0705070
     *33X,7HX(M) = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2//          S0705080
     *34X,64HFRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HS0705090
     *EIGHT/                                                            S0705100
     *34X,8HFRACT = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2//         S0705110
     *47X,37HDROP DIAMETER AS A FUNCTION OF HEIGHT/                     S0705120
     *30X,15HDROP(MICROM) = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2// S0705130
     *48X,35HDROP DIAMETER AS A FUNCTION OF TIME/                       S0705140
     *30X,15HDROP(MICROM) = ,E14.8,3H + ,E14.8,5H *T+ ,E14.8,6H *T**2)  S0705150
      END                                                               S0705160
```

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      SUBROUTINE TRMVL                                                  S0800010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0800020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0800030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0800040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0800050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0800060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0800070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0800080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0800090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0800100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0800110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0800120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0800130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TRFDEN(3),       S0800140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0800150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0800160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0800170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0800180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0800190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0800200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0800210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0800220
      INTEGER TITLE                                                     S0800230
C     CALCULATE THE TERMINAL VELOCITY OF THE UPPER, LOWER AND AVERAGE   S0800240
C     DROP SIZE                                                         S0800250
      DO 40 I=1,3                                                       S0800260
      T15 = RDN(I)*RDN(I)                                               S0800270
      T14 = T2*RDN(I)*T15                                               S0800280
      IF (T14 .GT. 24.0) GO TO 10                                       S0800290
      VSI(I) = T3*T15                                                   S0800300
      GO TO 40                                                          S0800310
   10 IF (T14 .LE. 1.64E10) GO TO 20                                    S0800320
      WRITE (IOTFIL,9001) K                                             S0800330
      STOP                                                              S0800340
C     GO TO 40                                                          S0800350
   20 L = 0                                                             S0800360
   30 L = L+1                                                           S0800370
      IF (T14 .GT. R(L+23)) GO TO 30                                    S0800380
```

```
      VSI(I) = T4*(R(L)*(T14/R(L+22))**(ALOG(R(L+1)/R(L))/ALOG(R(L+23)/ S0800390
     *R(L+22))))/RDN(I)                                                  S0800400
   40 CONTINUE                                                           S0800410
      RETURN                                                             S0800420
 9001 FORMAT (67H *** WARNING - UNABLE TO CALC. TERMINAL VELOCITY FOR DRS0800430
     *OP CATEGORY ,I2)                                                   S0800440
      END                                                                S0800450
```

```
      SUBROUTINE REGRS(N,X,Y,A,B,C,ISW2)                                S0900010
C     LEAST SQUARES 2ND ORDER POLYNOMIAL FIT                            S0900020
C     Y = A+B*X+C*X**2                                                  S0900030
      DIMENSION X(1),Y(1)                                               S0900040
      DOUBLE PRECISION SX,SXSQ,SXQB,SXFR,SY,SYX,SYXSQ,XSQ,XQB,XFR,F1,F2,S0900050
     *F3,F4,F5,XPX,XMX,XMXI,XP,YP,YMX,YMXI                              S0900060
      IF (N .LE. 1) GO TO 80                                            S0900070
      XMX = 0.0                                                         S0900080
      YMX = 0.0                                                         S0900090
      DO 10 I=1,N                                                       S0900100
      IF (ABS(X(I)) .GT. XMX) XMX = ABS(X(I))                           S0900110
      IF (ABS(Y(I)) .GT. YMX) YMX = ABS(Y(I))                           S0900120
   10 CONTINUE                                                          S0900130
      IF (XMX) 20,80,20                                                 S0900140
   20 IF (YMX) 30,80,30                                                 S0900150
   30 XMXI = 1.0/XMX                                                    S0900160
      YMXI = 1.0/YMX                                                    S0900170
      SX = 0.0                                                          S0900180
      SXSQ = 0.0                                                        S0900190
      SXQB = 0.0                                                        S0900200
      SXFR = 0.0                                                        S0900210
      SY = 0.0                                                          S0900220
      SYX = 0.0                                                         S0900230
      SYXSQ = 0.0                                                       S0900240
      DO 40 I=1,N                                                       S0900250
      XP = X(I)*XMXI                                                    S0900260
      YP = Y(I)*YMXI                                                    S0900270
      XSQ = XP*XP                                                       S0900280
      XQB = XSQ*XP                                                      S0900290
      XFR = XQB*XP                                                      S0900300
      SX = SX+XP                                                        S0900310
      SXSQ = SXSQ+XSQ                                                   S0900320
      SXQB = SXQB+XQB                                                   S0900330
      SXFR = SXFR+XFR                                                   S0900340
      SY = SY+YP                                                        S0900350
      SYX = SYX+XP*YP                                                   S0900360
      SYXSQ = SYXSQ+YP*XSQ                                              S0900370
   40 CONTINUE                                                          S0900380
```

```
      IF (ISW2 .EQ. 0.OR.N .LE. 2) GO TO 60                         S0900390
      F1 = SXSQ*SXFR-SXQB*SXQB                                      S0900400
      F2 = SX*SXFR-SXQB*SXSQ                                        S0900410
      F3 = SX*SXSQ-N*SXQB                                           S0900420
      F4 = SXSQ*SXSQ                                                S0900430
      F5 = SX*SXQB-F4                                               S0900440
      XPX = N*F1-SX*F2+SXSQ*F5                                      S0900450
      IF (XPX) 50,60,50                                             S0900460
   50 XPX = YMX/XPX                                                 S0900470
      F1 = F1*SY                                                    S0900480
      A = (F1-SYX*F2+SYXSQ*F5)*XPX                                  S0900490
      B = (-SY*F2+SYX*(N*SXFR-F4)+SYXSQ*F3)*XPX*XMXI                S0900500
      C = (SY*F5+SYX*F3+SYXSQ*(N*SXSQ-SX*SX))*XPX*XMXI*XMXI         S0900510
      GO TO 90                                                      S0900520
   60 XPX = N*SXSQ-SX*SX                                            S0900530
      IF (XPX) 70,80,70                                             S0900540
   70 XPX = YMX/XPX                                                 S0900550
      A = (SXSQ*SY-SX*SYX)*XPX                                      S0900560
      B = (-SX*SY+N*SYX)*XPX*XMXI                                   S0900570
      C = 0.0                                                       S0900580
      GO TO 90                                                      S0900590
   80 A = Y(1)                                                      S0900600
      B = 0.0                                                       S0900610
      C = 0.0                                                       S0900620
   90 RETURN                                                        S0900630
      END                                                           S0900640
```

```
      FUNCTION AVGRD(A,B)                                               S1000010
C     CALCULATE GEOMETRIC MEAN SIZE                                     S1000020
      IF (A-B) 10,20,10                                                 S1000030
   10 AVGRD = (2.5E-5*(A*(1.0E4*A*(A+B)+B*(1.0+1.0E4*B))+B*B*B*1.0E4))**S1000040
     *.33333333                                                         S1000050
      GO TO 30                                                          S1000060
   20 AVGRD = A                                                         S1000070
   30 RETURN                                                            S1000080
      END                                                               S1000090
```

```
      SUBROUTINE IOPUT(IO,JO,KO)                                        S1100010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S1100020
     *ISW(20),I,J,K,L,M,N,NVS                                           S1100030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S1100040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S1100050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S1100060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S1100070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S1100080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S1100090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S1100100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S1100110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S1100120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S1100130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S1100140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S1100150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S1100160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S1100170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S1100180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S1100190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S1100200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S1100210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S1100220
      INTEGER TITLE                                                     S1100230
C     SUBROUTINE TO PRINT HEADINGS FOR EVAPORATION AND CANOPY           S1100240
C     PENETRATION MODEL AND INPUT DATA.                                 S1100250
      IF (IO .EQ. 1) GO TO 10                                           S1100260
      LINE = LINE+1                                                     S1100270
      IF (LINE .LT. 57) GO TO 100                                       S1100280
   10 LINE = 3                                                          S1100290
      IPAGE = IPAGE+1                                                   S1100300
      WRITE (IOTFIL,9001) (TITLE(I1),I1=1,20),IDATE,IPAGE               S1100310
      IF (IO .EQ. 1) GO TO 20                                           S1100320
      WRITE (IOTFIL,9002) ITABLE                                        S1100330
      GO TO 30                                                          S1100340
   20 ITABLE = ITABLE+1                                                 S1100350
      WRITE (IOTFIL,9003) ITABLE                                        S1100360
   30 GO TO (40,50,90,50,100,100),JO                                    S1100370
   40 T15 = -1.0E15                                                     S1100380
```

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      WRITE (IOTFIL,9004) TIS                                           S1100390
      LINE = LINE+3                                                     S1100400
      GO TO 100                                                         S1100410
   50 IF (KO .EQ. 2) GO TO 60                                           S1100420
      WRITE (IOTFIL,9005)                                               S1100430
      GO TO 70                                                          S1100440
   60 WRITE (IOTFIL,9006)                                               S1100450
   70 LINE = LINE+3                                                     S1100460
      IF (IO .NE. 2) GO TO 80                                           S1100470
      WRITE (IOTFIL,9007) K,DRPLWR(K),DRPUPR(K)                         S1100480
      LINE = LINE+8                                                     S1100490
      GO TO 100                                                         S1100500
   80 IF (IO .NE. 3) GO TO 100                                          S1100510
      WRITE (IOTFIL,9008) K,DRPLWR(K),DRPUPR(K)                         S1100520
      LINE = LINE+3                                                     S1100530
      GO TO 100                                                         S1100540
   90 WRITE (IOTFIL,9009)                                               S1100550
      LINE = LINE+2                                                     S1100560
  100 RETURN                                                            S1100570
 9001 FORMAT (24H1FOREST SPRAY MODEL *** ,20A4,10H *** DATE ,2(I2,1H/), S1100580
     *I2,7H, PAGE ,I3/)                                                 S1100590
 9002 FORMAT (58X,6HTABLE ,I2,8H (CONT.))                               S1100600
 9003 FORMAT (62X,6HTABLE ,I2)                                          S1100610
 9004 FORMAT (1H0,54X,22H- PROGRAM INPUT DATA -/47X,8H(NOTE - ,F7.5,22H S1100620
     *MEANS NOT APPLICABLE)/)                                           S1100630
 9005 FORMAT (1H0,42X,47H- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -S1100640
     */)                                                                S1100650
 9006 FORMAT (1H0,42X,47H- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -S1100660
     */)                                                                S1100670
 9007 FORMAT (23X,51H- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY S1100680
     *,I2,2H (,F8.3,3H - ,F8.3,11H MICRO-M) -//17X,7H   DROP,10X,13HDROPS1100690
     * DIAMETER,10X,16HMASS LOST DUE TO,6X,33HFALL  ALONGWIND SETTLING  S1100700
     *PERCENT/17X,36H  HEIGHT   MAXIMUM  AVERAGE  MINIMUM,6X,11HEVAPORATS1100710
     *ION,9X,34HTIME   DISTANCE VELOCITY  MATERIAL/17X,10H (METERS) ,3(9S1100720
     *H(MICRO-M)),8H   TOTAL,6X,45HIN DH     (SEC)   (METERS)   (M/S)   S1100730
     *REACHING/56X,18H(GRAMS)    (GRAMS),32X,6HHEIGHT/18X,47(2H--),1H-) S1100740
 9008 FORMAT (26X,46H- CALCULATED EQUATIONS FOR DROP SIZE CATEGORY ,I2,2S1100750
     *H (,F8.3,3H - ,F8.3,11H MICRO-M) -//)                             S1100760
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      9009 FORMAT (40X,51H- CALCULATED VALUES FROM CANOPY PENETRATION MODEL -S1100770
          */)                                                               S1100780
           END                                                              S1100790
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      FUNCTION UNRAN(Z)                                                 S1200010
C     UNIFORM PSUEDO-RANDOM NUMBER GENERATOR BY THE MIXED MULTIPLICITIVES1200020
C     CONGRUENTIAL METHOD.                                              S1200030
      DOUBLE PRECISION A1,A,X,XM,B,C                                    S1200040
      DATA X,A,XM/5.66387D5,1.027D3,1.048576D6/                         S1200050
      A1 = A*X                                                          S1200060
      B = A1/XM                                                         S1200070
      C = B*1.0E-4                                                      S1200080
      J = C                                                             S1200090
      C = FLOAT(J)*1.0E4                                                S1200100
      J = B-C                                                           S1200110
      B = C+FLOAT(J)                                                    S1200120
      X = A1-B*XM                                                       S1200130
      Z = X/XM                                                          S1200140
      UNRAN = Z                                                         S1200150
      RETURN                                                            S1200160
      END                                                               S1200170
```

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      SUBROUTINE CANPY                                                  S1300010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S1300020
     *ISW(20),I,J,K,L,M,N,NVS                                           S1300030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S1300040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S1300050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S1300060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S1300070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S1300080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S1300090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S1300100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S1300110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S1300120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S1300130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TRFDEN(3),       S1300140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S1300150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S1300160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S1300170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S1300180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S1300190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S1300200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S1300210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S1300220
      DIMENSION RTMX(3),SPCT(3),HWRAT(3),SPCTI(3),ELTDI(20)             S1300230
      EQUIVALENCE (RTMX(1),RDST(1)),(SPCT(1),RDST(4)),(HWRAT(1),RDST(7))S1300240
     *,(SPCTI(1),RDST(10)),(ELTDI(1),XLOCS(1))                          S1300250
      INTEGER TITLE                                                     S1300260
C     THIS SUBROUTINE CALCULATES THE PERCENT OF MATERIAL OF EACH DROP   S1300270
C     SIZE CATEGORY THAT REACHES A GIVEN HEIGHT IN THE FOREST CANOPY.   S1300280
C     ALSO, THE HORIZONTAL DISTANCE FROM WHERE A DROP ENTERS THE CANOPY S1300290
C     TO THE POINT OF IMPACTION IS CALCULATED. THE METHOD IS A MONTE    S1300300
C     CARLO TECHNIQUE.                                                  S1300310
C                                                                       S1300320
C                                                                       S1300330
C                                                                       S1300340
      DO 20 I=1,20                                                      S1300350
      ELTDI(I) = 0.0                                                    S1300360
      DO 10 J=1,11                                                      S1300370
      DISTM(J,I) = 0.0                                                  S1300380
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   10 CNTD(J,I) = 0.0                                                       S1300390
      IF (I .GT. 3) GO TO 20                                                S1300400
      RTMX(I) = 0.0                                                         S1300410
      SPCT(I) = 0.0                                                         S1300420
      HWRAT(I) = 0.0                                                        S1300430
      SPCTI(I) = 0.0                                                        S1300440
   20 CONTINUE                                                              S1300450
C     DIVIDE THE TALLEST CLASS OF TREES INTO TENTHS                         S1300460
      V1 = HGTCAN(1)*0.1                                                    S1300470
C     DETERMINE NUMBER OF DROP SIZE CATEGORIES REACHING CANOPY              S1300480
      NVSS = 0                                                              S1300490
      DO 30 I=1,20                                                          S1300500
      IF (DRPUPR(I) .LE. 0.0) GO TO 40                                      S1300510
      NVSS = NVSS+1                                                         S1300520
   30 CONTINUE                                                              S1300530
   40 CONTINUE                                                              S1300540
      IF (NVSS .EQ. 0) GO TO 380                                            S1300550
C     CALCULATE THE NUMBER OF TREE HEIGHT CATEGORIES                        S1300560
      NT = 1                                                                S1300570
      IF (HGTCAN(2) .GT. 0.0) NT = NT+1                                     S1300580
      IF (HGTCAN(3) .GT. 0.0) NT = NT+1                                     S1300590
C     CHANGE TREE ENVELOPE TO RADIUS, SAVING THE MAXIMUM                    S1300600
      L = 0                                                                 S1300610
      DO 60 I=1,NT                                                          S1300620
      RTMX(I) = 0.0                                                         S1300630
      K = HGTCAN(I)                                                         S1300640
      DO 50 J =1,K                                                          S1300650
      TREENV(J+L) = TREENV(J+L)*0.5                                         S1300660
C     MAXIMUM TREE RADIUS                                                   S1300670
      IF (TREENV(J+L) .GT. RTMX(I)) RTMX(I) = TREENV(J+L)                   S1300680
   50 CONTINUE                                                              S1300690
   60 L = L+K                                                               S1300700
      DO 70 I=1,NT                                                          S1300710
C     CALCULATE THE SPACING BETWEEN TREES FOR EACH TREE HEIGHT CLASS        S1300720
      SPCT(I) = 63.614907/SQRT(TREDEN(I))                                   S1300730
C     CALCULATE THE RATIO OF TREE HEIGHT TO MAXIMUM WIDTH                   S1300740
      HWRAT(I) = HGTCAN(I)/(2.0*RTMX(I))                                    S1300750
C     INVERSE OF TREE SPACING                                               S1300760
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      SPCTI(I) = 1.0/SPCT(I)                                            S1300770
C     INVERSE OF ELEMENT SIZE FOR EACH CLASS OF TREES                   S1300780
      ELTDI(I) = 1.0/ABS(COLEFF(I))                                     S1300790
   70 CONTINUE                                                          S1300800
C                                                                       S1300810
      IF (COLEFF(1) .GE. 0.0) GO TO 80                                  S1300820
C     NEG. COLEFF INDICATES ELEMENT SIZE, MUST CALCULATE THE COLLECTION S1300830
C     EFFICIENCY                                                        S1300840
      Z1 = 0.25*HGTCAN(1)                                               S1300850
      Z2 = 0.5*HGTCAN(1)                                                S1300860
      Z3 = 0.75*HGTCAN(1)                                               S1300870
   80 CONTINUE                                                          S1300880
      IF (ISW(3) .GE. 3) WRITE (IOTFIL,9001) NVSS,NT,V1,RTMX,SPCT,HWRAT,S1300890
     *(ELTDI(I),I=1,3),Z1,Z2,Z3                                         S1300900
C  90                                                                   S1300910
C     BEGIN MAJOR LOOP OVER DROP SIZE CATEGORIES                        S1300920
      DO 370 L=1,NVSS                                                   S1300930
      IF (ABS(A14(L))+ABS(B14(L)) .LE. 0.0) GO TO 370                   S1300940
C     CALCULATE HORIZONTAL DISTANCE FROM DROP ENTRY POINT IN CANOPY TO  S1300950
C     TRAJECTORY INTERSECTION AT EACH TENTH OF THE CANOPY HEIGHT        S1300960
      ZP = HGTCAN(1)+V1                                                 S1300970
      DO 100 I=1,11                                                     S1300980
      ZP = ZP-V1                                                        S1300990
  100 DISTM(12-I,L) = B12(L)*(ZP-HGTCAN(1))+C12(L)*(ZP*ZP-HGTCAN(1)*HGTCS1301000
     *AN(1))                                                            S1301010
C     THE TOTAL NUMBER OF DROPS IN THE DISTRIBUTION IS NDRS             S1301020
      NDRPS = 500                                                       S1301030
C     INVERSE OF NDRPS                                                  S1301040
      XNDRPS = 1.0/NDRPS                                                S1301050
C     BEGIN MAJOR LOOP OVER THE NUMBER OF DROPS IN THE DISTRIBUTION     S1301060
      IF (ISW(3) .GE. 3) WRITE (IOTFIL,9002) L,NDRPS                    S1301070
C 110                                                                   S1301080
      DO 350 K=1,NDRPS                                                  S1301090
C     SET DEPTH OF PENETRATION EQUAL TO ZERO                            S1301100
      HPEN = 0.0                                                        S1301110
      L1 = 0                                                            S1301120
C     BEGIN MAJOR LOOP OVER TREE HEIGHT CLASSES                         S1301130
      DO 330 J=1,NT                                                     S1301140
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C       CALCULATE THE NUMBER OF TREES IN THE DROP TRAJECTORY PATH          S1301150
        NTREE = DISTM(1,L)*SPCTI(J)+1                                      S1301160
        IF (NTREE .LT. 2) NTREE = 2                                        S1301170
        IF (NTREE .GT. 1000) NTREE = 1000                                  S1301180
C       BEGIN LOOP OVER THE NUMBER OF TREES                                S1301190
        IF (ISW(3) .GE. 3) WRITE (IOTFIL,9003) K,J,NTREE                   S1301200
C 120                                                                      S1301210
        DO 280 I=1,NTREE                                                   S1301220
C       CALCULATE THE DISTANCE TO THIS TREE                                S1301230
        XP = (NTREE-I)*SPCT(J)                                             S1301240
C       CALCULATE RANDOM NUMBER                                            S1301250
        V2 = UNRAN(V3)                                                     S1301260
C       RANDOMLY DISTRIBUTE TREES ALONG TRAJECTORY PATH                    S1301270
        XP = XP+SPCT(J)*(V2-0.5)                                           S1301280
C       RANDOMLY DISTRIBUTE TREES ACROSS TRAJECTORY PATH                   S1301290
        V2= UNRAN(V3)                                                      S1301300
        YP = SPCT(J)*ABS(V2-0.5)                                           S1301310
        IF (ISW(3) .GE. 3) WRITE (IOTFIL,9004) I,XP,YP,V2                  S1301320
C 130                                                                      S1301330
        IF (I .LT. NTREE) GO TO 170                                        S1301340
C       LOOP OVER TENTHS OF THE TREE HEIGHT 10 CHECK F3R DR3P IMPACTION    S1301350
        IF (XP .LE. -RTMX(J)) GO TO 280                                    S1301360
        MH = HGTCAN(J)                                                     S1301370
        ZP = MH+1                                                          S1301380
C       LOOP OVER 1 METER HEIGHT LEVELS OF FOREST FROM TOP TO BOTTOM       S1301390
        DO 160 M=1,MH                                                      S1301400
        ZP = ZP-1.0                                                        S1301410
C       CALCULATE DROP SIZE TO SEE IF VAPOR                                S1301420
        DI = A14(L)+ZP*(B14(L)+ZP*C14(L))                                  S1301430
        IF (ISW(3) .GE. 3) WRITE (IOTFIL,9005) M,ZP,DI                     S1301440
C 140                                                                      S1301450
        IF (DI .LT. 5.0) GO TO 300                                         S1301460
C       CALCULATE DISTANCE FROM POINT DROP TRAJECTORY HITS GROUND          S1301470
C       UPWIND TO HEIGHT ZT ON TRAJECTORY                                  S1301480
        XR = ZP*(-B12(L)-C12(L)*ZP)                                        S1301490
C       CALCULATE LATERAL DISTANCE TO TREE                                 S1301500
        YR = SQRT((XP-XR)**2+YP*YP)                                        S1301510
C       IF THE RADIUS OF THE TREE IS GREATER THAN YR, THEN POSSIBLE HIT    S1301520
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      IF (ISW(3) .GE. 3) WRITE (IOTFIL,9006) XR,YR,TREENV(MH-M+1+L1)    S1301530
C 150                                                                   S1301540
      IF (TREENV(MH-M+1+L1) .GT. YR) GO TO 200                          S1301550
C     DROP MISSES TREE                                                  S1301560
  160 CONTINUE                                                          S1301570
      GO TO 290                                                         S1301580
  170 CONTINUE                                                          S1301590
C     LOOP OVER TREES ALONG THE TRAJECTORY PATH                         S1301600
C     CALCULATE THE HEIGHT OF THE TRAJECTORY AT DISTANCE XP             S1301610
      ZP = A12(L)-XP                                                    S1301620
      ZP = A11(L)+ZP*(B11(L)+C11(L)*ZP)                                 S1301630
      IF (ZP .GT. HGTCAN(J)) ZP = HGTCAN(J)                             S1301640
      IF (ZP .LT. 0.0) ZP = 0.0                                         S1301650
C     CALCULATE DROP SIZE TO SEE IF VAPOR                               S1301660
      DI = A14(L)+ZP*(B14(L)+ZP*C14(L))                                 S1301670
      IF (ISW(3) .GE. 3) WRITE (IOTFIL,9007) ZP,DI                      S1301680
C 180                                                                   S1301690
      IF (DI .LT. 5.0) GO TO 300                                        S1301700
C     CALCULATE THE RADIUS OF THE TREE AT ZP                            S1301710
      I1 = ZP                                                           S1301720
      RT = I1+1                                                         S1301730
      RT = TREENV(I1+1)-(TREENV(I1+1)-TREENV(I1))*(RT-ZP)               S1301740
C     IF THE RADIUS OF THE TREE IS GREATER THAN YP, THEN POSSIBLE HIT   S1301750
      IF (ISW(3) .GE. 3) WRITE (IOTFIL,9008) RT,YP                      S1301760
C 190                                                                   S1301770
      IF (RT .LE. ABS(YP)) GO TO 280                                    S1301780
C     POSSIBLE IMPACTION, DETERMINE PROBABILITY OF IMPACTION            S1301790
C     CALCULATE PATH LENGTH FACTOR XR                                   S1301800
  200 XR = XP+RT                                                        S1301810
      YR = A11(L)+XR*(B11(L)+C11(L)*XR)                                 S1301820
      XR = ZP-YR                                                        S1301830
      XR = SQRT(XR*XR+RT*RT)/RT                                         S1301840
      IF (XR .GT. HWRAT(J)) XR = HWRAT(J)                               S1301850
      IF (COLEFF(1) .GE. 0.0) GO TO 250                                 S1301860
C     MUST CALCULATE THE COLLECTION EFFICIENCY                          S1301870
C     CALCULATE DROP DIAMETER AT ZP                                     S1301880
      DI = A14(L)+ZP*(B14(L)+C14(L)*ZP)                                 S1301890
C     CALCULATE DROP IMPACTION VELOCITY                                 S1301900
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      VI = A10(L)+ZP*(B10(L)+C10(L)*ZP)                                 S1301910
      IF (ZP .LE. Z1) GO TO 230                                         S1301920
      IF (ZP .LE. Z2) GO TO 220                                         S1301930
      IF (ZP .LE. Z3) GO TO 210                                         S1301940
      U = WSIN44                                                        S1301950
      GO TO 240                                                         S1301960
  210 U = WSIN34                                                        S1301970
      GO TO 240                                                         S1301980
  220 U = WSIN24                                                        S1301990
      GO TO 240                                                         S1302000
  230 U = WSIN14                                                        S1302010
  240 U = SQRT(U*U+VI*VI)                                               S1302020
C     CALCULATE THE COLLECTION EFFICIENCY                               S1302030
      U = 2.8E-4*DI*DI*U*ELTDI(J)                                       S1302040
      GO TO 260                                                         S1302050
  250 U = COLEFF(L)                                                     S1302060
  260 CONTINUE                                                          S1302070
      IF (U .GT. 1.0) U = 1.0                                           S1302080
C     CALCULATE THE PROBABILITY                                         S1302090
      PR = (1.0-PRBPEN(J)**XR)*U                                        S1302100
C     CALCULATE RANDOM NUMBER                                           S1302110
      V2 = UNRAN(V3)                                                    S1302120
      IF (ISW(3) .GE. 3) WRITE (IOTFIL,9009) XR,YR,DI,VI,U              S1302130
     *,ZP,PR,V2                                                         S1302140
C 270                                                                   S1302150
      IF (V2 .LE. PR) GO TO 300                                         S1302160
C     END LOOP OVER TREES                                               S1302170
  280 CONTINUE                                                          S1302180
C     DROP IMPACTS ON GROUND                                            S1302190
  290 ZP = HGTCAN(1)                                                    S1302200
      GO TO 310                                                         S1302210
C     DROP IMPACTS AT HEIGHT ZP                                         S1302220
  300 ZP = HGTCAN(1)-ZP                                                 S1302230
C     SAVE MAXIMUM PENETRATION OF DROP THROUGH CANOPY                   S1302240
  310 IF (ZP .GT. HPEN) HPEN = ZP                                       S1302250
C     END OF LOOP OVER TREE HEIGHT CLASSES                              S1302260
      IF (ISW(3) .GE. 3) WRITE (IOTFIL,9010) ZP,HPEN                    S1302270
C 320                                                                   S1302280
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  330 L1 = L1+HGTCAN(J)                                                 S1302290
C     SUM THE NUMBER OF DROPS PASSING THE GIVEN HEIGHTS IN CANOPY       S1302300
      XP = 0.0                                                          S1302310
      DO 340 J=1,11                                                     S1302320
      IF (HPEN+.001 .LT. XP) GO TO 350                                  S1302330
      XP = XP+V1                                                        S1302340
  340 CNTD(12-J,L) = CNTD(12-J,L)+1.0                                   S1302350
C     END LOOP OVER DROPS IN DISTRIBUTION                               S1302360
  350 CONTINUE                                                          S1302370
C     CALCULATE FRACTION OF MATERIAL THAT REACHES EACH TENTH OF HEIGHT  S1302380
      DO 360 I=1,11                                                     S1302390
C                                                                       S1302400
  360 CNTD(I,L) = CNTD(I,L)*XNDRPS                                      S1302410
  370 CONTINUE                                                          S1302420
  380 CONTINUE                                                          S1302430
      IF (ISW(3) .LT. 2) GO TO 420                                      S1302440
      CALL IOPUT(1,3,0)                                                 S1302450
      ZP = HGTCAN(1)+V1                                                 S1302460
      DO 390 I=1,11                                                     S1302470
      ZP = ZP-V1                                                        S1302480
  390 SPCT(I) = ZP                                                      S1302490
      IF (SPCT(11) .LT. 0.0) SPCT(11) = 0.0                             S1302500
      WRITE (IOTFIL,9011) (SPCT(I),I=1,6)                               S1302510
      DO 400 I=1,NVS                                                    S1302520
  400 WRITE (IOTFIL,9012) I,(CNTD(12-J,I),DISTM(12-J,I),J=1,6)          S1302530
      WRITE (IOTFIL,9013) (SPCT(I),I=7,11)                              S1302540
      DO 410 I=1,NVS                                                    S1302550
  410 WRITE (IOTFIL,9012) I,(CNTD(12-J,I),DISTM(12-J,I),J=7,11)         S1302560
      LINE = 57                                                         S1302570
  420 RETURN                                                            S1302580
 9001 FORMAT (8H11 NVSS=,I2,4H NT=,I1,4H V1=,F5.2,6H RTMX=,3F8.5,6H SPCTS1302590
     *=,3F8.4/7H HWRAT=,3F8.3,7H ELTDI=,3F8.4,10H Z1,Z2,Z3=,3F8.4)      S1302600
 9002 FORMAT (26H 2 LOOP OVER SIZE CATEGORY,I3,8H, NDRPS=,I4)           S1302610
 9003 FORMAT (15H 3 DROP NUMBER=,I4,19H TREE HEIGHT CLASS=,I2,17H NUMBERS1302620
     * OF TREES=,I6)                                                    S1302630
 9004 FORMAT (15H 4 TREE NUMBER=,I6,3H X=,F10.4,3H Y=,F10.4,9H RAND. #=,S1302640
     *E14.8)                                                            S1302650
 9005 FORMAT (5H 5 M=,I4,4H ZP=,F8.4,4H DI=,F9.4)                       S1302660
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      9006 FORMAT (6H 6 XR=,F10.4,4H YR=,F10.4,8H TREENV=,F10.5)                S1302670
      9007 FORMAT (6H 7 ZP=,F10.4,4H DI=,F10.4)                                 S1302680
      9008 FORMAT (6H 8 RT=,F10.4,4H YP=,F10.4)                                 S1302690
      9009 FORMAT (6H 9 XR=,F10.4,4H YR=,F10.4,4H DI=,F10.4,4H VI=,F10.4,3H US1302700
          1=,F10.4,4H ZP=,F10.4,4H PR=,F10.4,4H V2=,F10.4)                      S1302710
      9010 FORMAT (7H 10 ZP=,F10.4,6H HPEN=,F10.4)                              S1302720
      9011 FORMAT (1H0,3X,4HDROP,15X,55HFRACTION/DISTANCE OF MATERIAL REACHINS1302730
          1G INDICATED HEIGHT/3X,7HSIZE  /,6(6H  HGT=,F5.1,5H M  /)/10H CATEGS1302740
          2ORY/,6(16H FRACT /DIST(M)/)/1X,52(2H--),1H-)                         S1302750
      9012 FORMAT (4X,I2,3X,6(F8.5,F8.1))                                       S1302760
      9013 FORMAT (1H0,3X,4HDROP,15X,55HFRACTION/DISTANCE OF MATERIAL REACHINS1302770
          1G INDICATED HEIGHT/3X,7HSIZE  /,5(6H  HGT=,F5.1,5H M  /)/10H CATEGS1302780
          2ORY/,5(16H FRACT /DIST(M)/)/1X,44(2H--),1H-)                         S1302790
           END                                                                  S1302800
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      SUBROUTINE TEST(TIMT)                                             S1400010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S1400020
     *ISW(20),I,J,K,L,M,N,NVS                                           S1400030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S1400040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S1400050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S1400060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S1400070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S1400080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S1400090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S1400100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S1400110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S1400120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S1400130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S1400140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S1400150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S1400160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S1400170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S1400180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S1400190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S1400200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S1400210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S1400220
      DIMENSION TIMT(1)                                                 S1400230
      INTEGER TITLE                                                     S1400240
C     THIS SUBROUTINE PRINTS THE ACTUAL VALUE VERSUS THE VALUE          S1400250
C     CALCULATED VIA THE EQUATIONS DETERMINED BY REGRESSION FOR ABOVE   S1400260
C     AND BELOW CANOPY EVAPORATION. THE COLUMN TITLED ERROR IS THE      S1400270
C     PERCENTAGE INCREASE OR DECREASE BETWEEN THE PREDICTED TO ACTUAL   S1400280
C     VALUE - ERROR = 100.0*(1.0-PREDICTED/ACTUAL)                      S1400290
C                                                                       S1400300
      IF (IFUP .EQ. 2) GO TO 70                                         S1400310
      WRITE (IOTFIL,9001)                                               S1400320
      DO 60 I=1,N                                                       S1400330
      VSP = A1(K)+XDO(I)*(B1(K)+XDO(I)*C1(K))                           S1400340
      HGT = A2(K)+XDO(I)*(B2(K)+XDO(I)*C2(K))                           S1400350
      TMT = A3(K)+HIO(I)*(B3(K)+HIO(I)*C3(K))                           S1400360
      TMT = TMT*100.0                                                   S1400370
      IF (C2(K)) 10,20,10                                               S1400380
```

```
   10 CONTINUE                                                          S1400390
      XPP = B2(K)*B2(K)-4.0*(A2(K)-HIO(I))*C2(K)                        S1400400
      IF (XPP .LT. 0.0) XPP = 0.0                                       S1400410
      XDTP = (-B2(K)-SQRT(XPP))/(2.0*C2(K))                             S1400420
      GO TO 50                                                          S1400430
   20 IF (B2(K)) 30,40,30                                               S1400440
   30 XDTP = (HIO(I)-A2(K))/B2(K)                                       S1400450
      GO TO 50                                                          S1400460
   40 XDTP = 0.0                                                        S1400470
   50 CONTINUE                                                          S1400480
      TM = A4(K)+HIO(I)*(B4(K)+HIO(I)*C4(K))                            S1400490
      CALL TESS(W1,HGT,HIO(I))                                          S1400500
      CALL TESS(W2,XDTP,XDO(I))                                         S1400510
      CALL TESS(W3,VSP,VSSO(I))                                         S1400520
      CALL TFSS(W5,TM,TIMT(I))                                          S1400530
      W1 = 100.0*(W1-1.0)                                               S1400540
      W2 = 100.0*(W2-1.0)                                               S1400550
      W3 = 100.0*(W3-1.0)                                               S1400560
      W5 = 100.0*(W5-1.0)                                               S1400570
      TMPP = TMSLO(I)*100.0                                             S1400580
      CALL TESS(W4,TMT,TMPP)                                            S1400590
      W4 = 100.0*(W4-1.0)                                               S1400600
      WRITE (IOTFIL,9002) HIO(I),HGT,W1,XDO(I),XDTP,W2,VSSO(I),VSP,W3,  S1400610
     1TMPP,TMT,W4,TIMT(I),TM,W5                                         S1400620
   60 CONTINUE                                                          S1400630
      GO TO 190                                                         S1400640
   70 WRITE (IOTFIL,9003)                                               S1400650
      DO 180 I=1,N                                                      S1400660
      VSP = A10(K)+HIO(I)*(B10(K)+HIO(I)*C10(K))                        S1400670
      HGT = A11(K)+XDO(I)*(B11(K)+XDO(I)*C11(K))                        S1400680
      XDT = A12(K)+HIO(I)*(B12(K)+HIO(I)*C12(K))                        S1400690
      TMT = A13(K)+HIO(I)*(B13(K)+HIO(I)*C13(K))                        S1400700
      TMT = TMT*100.0                                                   S1400710
      DRT = A14(K)+HIO(I)*(B14(K)+HIO(I)*C14(K))                        S1400720
      IF (C11(K)) 80,90,80                                              S1400730
   80 CONTINUE                                                          S1400740
      XPP = B11(K)*B11(K)-4.0*(A11(K)-HIO(I))*C11(K)                    S1400750
      IF (XPP .LT. 0.0) XPP = 0.0                                       S1400760
```

```
      XDTP = (-B11(K)-SQRT(XPP))/(2.0*C11(K))                           S1400770
      GO TO 120                                                         S1400780
   90 IF (B11(K)) 100,110,100                                           S1400790
  100 XDTP = (HIO(I)-A11(K))/B11(K)                                     S1400800
      GO TO 120                                                         S1400810
  110 XDTP = 0.0                                                        S1400820
  120 IF (C12(K)) 130,140,130                                           S1400830
  130 CONTINUE                                                          S1400840
      XPP = B12(K)*B12(K)-4.0*(A12(K)-XDO(I))*C12(K)                    S1400850
      IF (XPP .LT. 0.0) XPP = 0.0                                       S1400860
      HGTP = (-B12(K)-SQRT(XPP))/(2.0*C12(K))                           S1400870
      GO TO 170                                                         S1400880
  140 IF (B12(K)) 150,160,150                                           S1400890
  150 HGTP = (XDO(I)-A12(K))/B12(K)                                     S1400900
      GO TO 170                                                         S1400910
  160 HGTP = 0.0                                                        S1400920
  170 CONTINUE                                                          S1400930
      CALL TESS(W1,HGT,HIO(I))                                          S1400940
      CALL TESS(W2,XDTP,XDO(I))                                         S1400950
      CALL TESS(W3,VSP,VSSO(I))                                         S1400960
      W1 = 100.0*(W1-1.0)                                               S1400970
      W2 = 100.0*(W2-1.0)                                               S1400980
      W3 = 100.0*(W3-1.0)                                               S1400990
      W6 = TMSLO(I)*100.0                                               S1401000
      CALL TESS(W4,TMT,W6)                                              S1401010
      CALL TESS(W5,DRT,DRPDM(I))                                        S1401020
      W4 = 100.0*(W4-1.0)                                               S1401030
      W5 = 100.0*(W5-1.0)                                               S1401040
      WRITE (IOTFIL,9002) HIO(I),HGT,W1,XDO(I),XDTP,W2,VSSO(I),VSP,W3,  S1401050
     1W6,TMT,W4,DRPDM(I),DRT,W5                                         S1401060
  180 CONTINUE                                                          S1401070
  190 RETURN                                                            S1401080
 9001 FORMAT (1H1,9X,6HHEIGHT,9X,1H/,11X,8HDISTANCE,9X,1H/,9X,2HVS,11X,1S1401090
     *H/,10X,4H%MAT,10X,1H/,11X,4HTIME/129H   EXACT  APPROX    ERROR    S1401100
     * EXACT    APPROX    ERROR  EXACT APPROX    ERROR   EXACT  APPROX  S1401110
     *  ERROR    EXACT   APPROX    ERROR/1X,65(2H--)/113H ERROR IS THE PS1401120
     *ERCENT CHANGE OR ERROR = 100.0*(1.0-APPROX/EXACT), WHERE EXACT=EXAS1401130
     *CT VALUE, APPROX=PREDICTED VALUE)                                 S1401140
```

```
9002 FORMAT (2(1X,F7.3),F9.3,2F10.3,F9.3,2F7.4,F9.3,2F8.3,4F9.3)        S1401150
9003 FORMAT (1H1,9X,6HHEIGHT,9X,1H/,11X,8HDISTANCE,9X,1H/,9X,2HVS,11X,1S1401160
    *H/,10X,4H%MAT,10X,1H/,11X,4HDROP/129H   EXACT  APPROX    ERROR    S1401170
    * EXACT    APPROX    ERROR  EXACT APPROX    ERROR   EXACT  APPROX  S1401180
    *  ERROR    EXACT    APPROX    ERROR/1X,65(2H--)/113H ERROR IS THE PS1401190
    *ERCENT CHANGE OR ERROR = 100.0*(1.0-APPROX/EXACT), WHERE EXACT=EXAS1401200
    *CT VALUE, APPROX=PREDICTED VALUE)                                  S1401210
     END                                                                S1401220
```

```
      SUBROUTINE TESS(W,A1,A2)                                          S1500010
      IF (A1) 10,30,10                                                  S1500020
   10 IF (A2) 20,60,20                                                  S1500030
   20 W = A1/A2                                                         S1500040
      GO TO 70                                                          S1500050
   30 IF (A2) 40,50,40                                                  S1500060
   40 W = 0.0                                                           S1500070
      GO TO 70                                                          S1500080
   50 W = 1.0                                                           S1500090
      GO TO 70                                                          S1500100
   60 W = 1.0E30                                                        S1500110
   70 RETURN                                                            S1500120
      END                                                               S1500130
```

```
      SUBROUTINE CBGS4                                                  S1600010
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S1600020
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S1600030
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4                          S1600040
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S1600050
     *ISW(20),I,J,K,L,M,N,NVS                                          S1600060
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S1600070
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S1600080
     *HM,DX(50),DY(50),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),     S1600090
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S1600100
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S1600110
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA    S1600120
     *,BFTA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S1600130
      COMMON /COM3/ CALC(737,3),XPF,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S1600140
     *SNMYP,SNMYPS,A10,AFI,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S1600150
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S1600160
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S1600170
      DIMENSION ZERO(1)                                                 S1600180
      EQUIVALENCE (ZERO(1),CALC(1,1))                                   S1600190
      INTEGER TITLE                                                     S1600200
C     THIS ROUTINE IS THE MAIN ROUTINE OF THE DISPERSION MODELS ROUTINESS1600210
C                                                                       S1600220
C                                                                       S1600230
C     SET MODEL CONSTANTS                                               S1600240
      DO 10 I=1,2285                                                    S1600250
   10 ZERO(I) = 0.0                                                     S1600260
C     RAD IS PI/180                                                     S1600270
      RAD = .01745329252D0                                              S1600280
C     SQR2 = SQRT(2)                                                    S1600290
      SQR2 = 1.414213562                                                S1600300
C     SQRP = SQRT(PI)                                                   S1600310
      SQRP = 1.772453851                                                S1600320
      IF (SIGAP .GE. 1.0) SIGAP = SIGAP*RAD                             S1600330
      IF (SIGEP .GE. 1.0) SIGEP = SIGEP*RAD                             S1600340
      IF (TAU-TAUO) 20,30,20                                            S1600350
   20 SIGAP = SIGAP*(TAU/TAUO)**0.2                                     S1600360
   30 CONTINUE                                                          S1600370
      UBARSI = 1.0/WSOCAN                                               S1600380
```

```
      DELU = DELU*UBARSI*.13953488                                      S1600390
C     .13953488 = 0.6/4.3                                               S1600400
   40 CONTINUE                                                          S1600410
      CALL CBGS5                                                        S1600420
      RETURN                                                            S1600430
      END                                                               S1600440
```

```
      SUBROUTINE CBGS5                                                  S1700010
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S1700020
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S1700030
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4,TT7,XP                    S1700040
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S1700050
     *ISW(20),I,J,K,L,M,N,NVS                                           S1700060
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S1700070
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S1700080
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S1700090
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S1700100
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S1700110
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA    S1700120
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S1700130
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S1700140
     *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S1700150
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S1700160
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S1700170
      DIMENSION XDO(20)                                                 S1700180
      EQUIVALENCE (SIGZI,SNMYP),(SIGZ,SBI),(SIGYI,API),(XY,SNMYPS),     S1700190
     *(SIGZI2,APIP)                                                     S1700200
      INTEGER TITLE                                                     S1700210
      SIGAPR = SIGAP                                                    S1700220
      SIGEPR = SIGEP                                                    S1700230
      IZ = 0                                                            S1700240
      HM = HM-HGTCAN(1)                                                 S1700250
      IF (Z .GE. HGTCAN(1)) GO TO 50                                    S1700260
C     IZ = 0, FOR NO CANOPY OR Z >= HGTCAN(1)                           S1700270
C     IZ = 1, FOR CANOPY WITH Z = 0.0                                   S1700280
C     IZ = I, FOR CANOPY WITH Z > .1*(I-2)*HGTCAN(1) AND Z <= .1*(I-1)* S1700290
C             HGTCAN(1)                                                 S1700300
      IZ = 1                                                            S1700310
      IF (Z .LE. 0.0) GO TO 30                                          S1700320
      DO 10 I=2,11                                                      S1700330
      IF (Z .LE. 0.1*FLOAT(I-1)*HGTCAN(1)) GO TO 20                     S1700340
   10 CONTINUE                                                          S1700350
      I = 11                                                            S1700360
   20 IZ = I                                                            S1700370
C     DETERMINE NUMBER OF DROP SIZE CATEGORIES                          S1700380
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```
   30 NTVS = 0                                                            S1700390
      DO 40 I=1,20                                                        S1700400
      IF (VSSS(I) .LE. 0.0) GO TO 50                                      S1700410
   40 NTVS = NTVS+1                                                       S1700420
   50 CONTINUE                                                            S1700430
      ZP = 0.0                                                            S1700440
      IF (Z .GT. HGTCAN(1)) ZP = Z-HGTCAN(1)                              S1700450
      T3 = 0.5*WNGSPN+HGTCAN(1)                                           S1700460
C     CALCULATE TIME FOR DROP TRAJECTORY TO REACH HEIGHT WNGSPN/2 ABOVE S1700470
C     CANOPY (T4) FOR CASES WHERE WAKVEL >= THE DROP SETTLING VELOCITY. S1700480
      T4 = 0.0                                                            S1700490
      IF (WAKVEL .GT. 0.0) T4 = (HGTCFT-T3)/WAKVEL                        S1700500
      IF (T4 .LT. 0.0) T4 = 0.0                                           S1700510
C     CALCULATE PARTS OF THE DISPERSION MODELS                            S1700520
      B1 = SIGXYZ/SIGEPR                                                  S1700530
      B3 = Q*3.9894228E-1                                                 S1700540
      DELTAH = 1.0                                                        S1700550
      TT5 = 1.0/SIGEPR                                                    S1700560
      TT6 = BETA1*TT5                                                     S1700570
C     TT8 IS (DELTAH)/SQRT(12)                                            S1700580
      TT8 = DELTAH*2.886751E-1                                            S1700590
      T5 = TT8*TT5                                                        S1700600
      XLRZY = XLRZ                                                        S1700610
      T6 = 0.5*DELTAH                                                     S1700620
      T7 = SIGXYZ/SIGAPR                                                  S1700630
      T8 = TT8/SIGAPR                                                     S1700640
      SIGX1 = SIGXYZ*SIGXYZ                                               S1700650
      SIGX2 = TT8*TT8                                                     S1700660
      TT10 = Q*.15915494                                                  S1700670
      A1 = SQR2*SIGAPR                                                    S1700680
      A2 = SIGAPR*TT5                                                     S1700690
      IF (SIGAPR-SIGEPR) 70,60,70                                         S1700700
   60 A2 = 1.0                                                            S1700710
   70 CONTINUE                                                            S1700720
      A3 = A2*TT10                                                        S1700730
      SK = A2                                                             S1700740
      A2 = A2*A2                                                          S1700750
      A6 = 1.0/A1                                                         S1700760
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      A8 = A6*UBARSI                                                    S1700770
C     THETAP IS AZIMUTH WIND DIRECTION.                                 S1700780
      THETAP = THETA+180.0                                              S1700790
      IF (THETAP .GE. 360.0) THETAP = THETAP-360.0                      S1700800
      K = 0                                                             S1700810
   80 K = K+1                                                           S1700820
C                                                                       S1700830
C                                                                       S1700840
C                                                                       S1700850
C                                                                       S1700860
C                                                                       S1700870
C*********************************************************************** S1700880
C     BEGIN LOOP OVER LINE SOURCES.                                     S1700890
C                                                                       S1700900
C                                                                       S1700910
C                                                                       S1700920
      IF (K .LE. NSOURC) GO TO 100                                      S1700930
C     GO PRINT DISPERSION MODEL CALCULATIONS                            S1700940
   90 CONTINUE                                                          S1700950
      CALL CBGS6                                                        S1700960
      RETURN                                                            S1700970
  100 L = 2*K-1                                                         S1700980
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9001) K,DX(L),DY(L),DX(L+1),     S1700990
     *DY(L+1)                                                           S1701000
C     TL IS LENGTH OF LINE SOURCES BUT NOT NECESSARILY THE EFFECTIVE    S1701010
C     LENGTH.                                                           S1701020
      TL = SQRT((DX(L+1)-DX(L))**2+(DY(L+1)-DY(L))**2)                  S1701030
C     GAM IS ANGLE FROM NORTH TO LINE SOURCE.                           S1701040
      GAM = ATAN2(DX(L+1)-DX(L),DY(L+1)-DY(L))*57.29577951              S1701050
      IF (GAM .LT. 0.0) GAM = GAM+360.0                                 S1701060
C     ALPH IS ANGULAR DIFFERENCE OF LINE SOURCE & WIND DIRECTION.       S1701070
C     CHECK TO SEE IF WITHIN 90 DEGREE DIFFERENCE.                      S1701080
      ALPH = ABS(THETAP-GAM)                                            S1701090
      IF (ALPH .LE. 90.0) GO TO 110                                     S1701100
      IF (360.0-ALPH .LE. 90.0) GO TO 110                               S1701110
C     EXCHANGE END POINTS OF LINE SOURCE & ADD 180 DEGREES TO GAM.      S1701120
      B6 = DX(L+1)                                                      S1701130
      DX(L+1) = DX(L)                                                   S1701140
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      DX(L) = B6                                                        S1701150
      B6 = DY(L+1)                                                      S1701160
      DY(L+1) = DY(L)                                                   S1701170
      DY(L) = B6                                                        S1701180
      GAM = GAM+180.0                                                   S1701190
      IF (GAM .GT. 360.0) GAM = GAM-360.0                               S1701200
      ALPH = ABS(THETAP-GAM)                                            S1701210
      IF (ALPH .GT. 180.0) ALPH = 360.0-ALPH                            S1701220
  110 IF (ALPH .GE. 90.0) ALPH = 360.0-ALPH                             S1701230
C     MODEL = 1 IS LINE SOURCE AND WIND DIRECTION ARE NOT NORMAL NOR    S1701240
C     ARE THEY PARALLEL TO EACH OTHER.                                  S1701250
      MODEL = 1                                                         S1701260
      IF (ALPH .GE. 0.5.AND.ALPH .LE. 89.5) GO TO 120                   S1701270
C     MODEL = 2 IS LINE SOURCE AND WIND DIRECTION ARE NORMAL TO EACH    S1701280
C     OTHER.                                                            S1701290
      IF (ALPH .GE. 89.5) MODEL = 2                                     S1701300
C     MODEL = 3 IS LINE SOURCE AND WIND DIRECTION ARE PARALLEL TO EACH  S1701310
C     OTHER.                                                            S1701320
      IF (ALPH .LE. 0.5) MODEL = 3                                      S1701330
  120 GO TO (130,140,130),MODEL                                         S1701340
C     BET IS THE THETA USED IN MODEL EQUATIONS.                         S1701350
  130 BET = 90.0-ALPH                                                   S1701360
      IF (MODEL .EQ. 3) BET = 90.0                                      S1701370
      A5 = BET*RAD                                                      S1701380
      TSIN = DSIN(A5)                                                   S1701390
      TCOS = DCOS(A5)                                                   S1701400
      TT1 = TCOS*TCOS                                                   S1701410
      TT2 = 0.0                                                         S1701420
      IF (MODEL .NE. 3) TT2 = 1.0/(TCOS*TSIN)                           S1701430
      TT3 = TCOS/TSIN                                                   S1701440
      TT4 = TL*TSIN                                                     S1701450
      TT7 = 2.0/TSIN                                                    S1701460
      A5 = A6*TT3                                                       S1701470
C     TRIG SIN & COS FOR ROTATION & TRANSLATION OF AXES FROM X,Y TO     S1701480
C     XR,YR MODEL SYSTEM.                                               S1701490
      GAM1 = (GAM+180.0)*RAD                                            S1701500
      RCOS = COS(GAM1)                                                  S1701510
      RSIN = SIN(GAM1)                                                  S1701520
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      A7 = A5*A5                                                        S1701530
      SN2 = A3*TT7                                                      S1701540
      SN3 = 0.5*SN2/(SK*SIGAPR)                                         S1701550
      GO TO 150                                                         S1701560
  140 BET = 0.0                                                         S1701570
      GAM1 = (GAM+180.0)*RAD                                            S1701580
      TSIN = 0.0                                                        S1701590
      TCOS = 1.0                                                        S1701600
      TT1 = 1.0                                                         S1701610
      TT2 = 0.0                                                         S1701620
      TT3 = 0.0                                                         S1701630
      TT4 = 0.0                                                         S1701640
      B6 = THETA*RAD                                                    S1701650
      RCOS = COS(B6)                                                    S1701660
      RSIN = SIN(B6)                                                    S1701670
      T1 = 0.5*(DX(L)+DX(L+1))                                          S1701680
      T2 = 0.5*(DY(L)+DY(L+1))                                          S1701690
      SN2 = B3                                                          S1701700
      SN3 = B3                                                          S1701710
      T12 = 0.5*TL                                                      S1701711
  150 CONTINUE                                                          S1701720
      T9 = 0.5*TSIN                                                     S1701730
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9002) MODEL,SIGAPR,SIGEPR,B3,A1, S1701740
     *A2,A3,SK,A6,THETAP,B1,TL,GAM,ALPH,BET,TSIN,TCOS,A5,RCOS,RSIN,A7,  S1701750
     *SN2,SN3,T1,T2                                                     S1701760
C                                                                       S1701770
C                                                                       S1701780
C                                                                       S1701790
C                                                                       S1701800
C                                                                       S1701810
C                                                                       S1701820
C********************************************************************** S1701830
C     BEGIN LOOP OVER RECEPTOR POINTS                                   S1701840
C                                                                       S1701850
C                                                                       S1701860
C                                                                       S1701870
C                                                                       S1701880
      M = 1                                                             S1701890
```

```
      J = 0                                                             S1701900
C     LOOP OVER Y RECEPTORS                                             S1701910
  160 J = J+1                                                           S1701920
      IF (J .GT. NYPNTS) GO TO 190                                      S1701930
      JJ = (J-1)*NXPNTS                                                 S1701940
      I = 0                                                             S1701950
C     LOOP OVER X RECEPTORS                                             S1701960
  170 I = I+1                                                           S1701970
      IF (I .GT. NXPNTS) GO TO 160                                      S1701980
  180 II = I+JJ                                                         S1701990
      GO TO 210                                                         S1702000
  190 IF (NXYPNT .LE. 0) GO TO 80                                       S1702010
      I = NXPNTS                                                        S1702020
      J = NYPNTS                                                        S1702030
      JJ = NXPNTS*NYPNTS-NXPNTS                                         S1702040
      M = 2                                                             S1702050
C     LOOP OVER DISCRETE RECEPTORS                                      S1702060
  200 I = I+1                                                           S1702070
      J = J+1                                                           S1702080
      IF (I .GT. NXYPNT+NXPNTS) GO TO 80                                S1702090
      GO TO 180                                                         S1702100
  210 CONTINUE                                                          S1702110
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9003) I,J,X(I),Y(J),M,JJ,II      S1702120
C     CALC DOWN AND CROSSWIND DIST TO RECEPTOR                          S1702130
      IF (MODEL .EQ. 2) GO TO 250                                       S1702140
      X1 = X(I)-DX(L)                                                   S1702150
      Y1 = Y(J)-DY(L)                                                   S1702160
      YRR = -X1*RSIN - Y1*RCOS                                          S1702170
      XRR = -X1*RCOS + Y1*RSIN                                          S1702180
      IF(ABS(THETAP-GAM) .GT. 180.0) GO TO 230                          S1702190
      IF(THETAP .GE. GAM) GO TO 240                                     S1702200
  220 XRR = -XRR                                                        S1702210
      GO TO 240                                                         S1702220
  230 IF(THETAP .GT. GAM) GO TO 220                                     S1702230
  240 CONTINUE                                                          S1702240
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9004) X1,Y1,XRR,YRR              S1702250
      XR = XRR                                                          S1702260
      YR = YRR                                                          S1702270
```

```
      XP = XR*TCOS+YR*TSIN                                              S1702280
      IF (MODEL .EQ. 3) YP = DABS(XR)                                   S1702290
      XPP = XP                                                          S1702300
      GO TO 260                                                         S1702310
  250 X1 = X(I)-T1                                                      S1702320
      Y1 = Y(J)-T2                                                      S1702330
      XR = -X1*RSIN-Y1*RCOS                                             S1702340
      YR =  X1*RCOS-Y1*RSIN                                             S1702350
      XP = XR                                                           S1702360
      XPP = XR                                                          S1702370
      YP = YR                                                           S1702380
      T10 = (T12+YP)*.70710678                                          S1702381
      T11 = (T12-YP)*.70710678                                          S1702382
  260 CONTINUE                                                          S1702390
      IF (IZ .EQ. 0.AND.XPP .LE. 0.0) GO TO (170,200),M                 S1702400
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9005) XR,YR,XP,YP,XPP            S1702410
C                                                                       S1702420
C                                                                       S1702430
C                                                                       S1702440
C                                                                       S1702450
C                                                                       S1702460
C                                                                       S1702470
C*********************************************************************** S1702480
C     BEGIN LOOP OVER DROP SIZE CATEGORIES                              S1702490
C                                                                       S1702500
C                                                                       S1702510
C                                                                       S1702520
C                                                                       S1702530
      N = 0                                                             S1702540
      TSUM1 = 0.0                                                       S1702550
      TSUM2 = 0.0                                                       S1702560
      TSUM3 = 0.0                                                       S1702570
  270 N = N+1                                                           S1702580
      IF (N .GT. NVS) GO TO 720                                         S1702590
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9006) N,IZ,MODEL                 S1702600
      IF (IZ .NE. 0.AND.VSSS(N) .LE. 0.0) GO TO 270                     S1702610
C     KT = 1, FOR DROP MODEL CALCULATIONS                               S1702620
C     KT = 2, FOR VAPOR MODEL CALCULATIONS                              S1702630
```

```
            KT = 1                                                          S1702540
      C     XM IS HORIZONTAL DISTANCE DROP TRAVELS IN CANOPY                S1702550
            XM = 0.0                                                        S1702560
            IF (IZ .NE. 0) XM = DISTM(IZ,N)                                 S1702570
            GO TO 300                                                       S1702580
        280 IF (IZ .NE. 0) GO TO 270                                        S1702590
            IF (ISW(9) .EQ. 0) GO TO 270                                    S1702700
            IF (ISW(6) .EQ. 0.AND.ISW(7) .EQ. 0) GO TO 270                  S1702710
            KN = 0                                                          S1702720
      C     BEGIN VAPOR MODEL CALCULATIONS                                  S1702730
            KT = 2                                                          S1702740
            VAP = 0.0                                                       S1702750
            H = HGTCFT+T6                                                   S1702760
            VS = 0.0                                                        S1702770
      C     FOLLOW DROP (VOLUME SOURCE) DOWN IN DECREMENTS OF DELTAH        S1702780
      C     WHEN DROP HAS COMPLETELY EVAPORATED THE SWITCH KN IS SET TO 1.  S1702790
        290 H = H-DELTAH                                                    S1702800
            IF (KN .NE. 0.OR.H .LE. HGTCAN(1)) GO TO 270                    S1702810
      C     CALCULATE TIME TO DROP HEIGHT ABOVE CANOPY (VOLUME SOURCE)      S1702820
            A4 = AX4(N)+H*(BX4(N)+H*CX4(N))                                 S1702830
      C     CALCULATE HORIZONTAL DISTANCE TO DROP.                          S1702840
            XM = WSOCAN*A4                                                  S1702850
        300 CONTINUE                                                        S1702860
      C     ADJUST ALONGWIND DISTANCE TO RECEPTOR FOR DISTANCE DROP HAS     S1702870
      C     TRAVELED.                                                       S1702880
            XPP = XP-XM                                                     S1702890
            IF (XPP .LE. 0.0) GO TO 270                                     S1702900
            IF (MODEL .EQ. 2) GO TO 310                                     S1702910
      C     PARALLEL ALONG THE LINE SOURCE DISTANCE TO RECEPTOR RELATIVE TO S1702920
      C     UPWIND END OF LINE SOURCE.                                      S1702930
            YR = YRR-XM*TSIN                                                S1702940
      C     NORMAL ACROSS THE LINE SOURCE DISTANCE TO THE RECEPTOR.         S1702950
            XR = XRR-XM*TCOS                                                S1702960
        310 CONTINUE                                                        S1702970
            SL = 0.0                                                        S1702980
      C     CALCULATE THE EFFECTIVE LENGTH OF THE LINE SOURCE               S1702990
            IF (MODEL .NE. 2) SL = YR+XR*TT3                                S1703000
            IF (SL .GT. TL) SL = -TL                                        S1703010
```

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      C     CALCULATE THE EFFECTIVE ALONGWIND DISTANCE FROM LINE SOURCE TO    S1703020
      C     RECEPTOR.                                                         S1703030
            XBAR = XPP-ABS(SL)*T9                                             S1703040
            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9007) XM,XPP,XP,YP,XR,YR,XBAR,T10S1703120
           *,T11,SL                                                           S1703130
      C                                                                       S1703140
      C                                                                       S1703150
      C     CALC. TIME TO STABILIZATION.                                      S1703160
      C                                                                       S1703170
      C     INITIAL DROP SETTLING VELOCITY AT AIRCRAFT ALTITUDE (VSP)         S1703180
            VSP = AX1(N)                                                      S1703190
            IF (WAKVEL .GE. VSP) GO TO 330                                    S1703200
      C     CALC. TIME TO HEIGHT WNGSPN/2 ABOVE CANOPY FROM TIME VS. HEIGHT   S1703210
      C     FUNCTION FOR ABOVE CANOPY DROPS.                                  S1703220
            TIME = AX4(N)+T3*(BX4(N)+T3*CX4(N))                               S1703230
            GO TO 340                                                         S1703240
        330 TIME = T4                                                         S1703250
        340 CONTINUE                                                          S1703260
            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9008) VSP,T3,TIME                S1703270
            IF (KT .EQ. 2) GO TO 400                                          S1703280
      C     CALC. VS AT HEIGHT WNGSPN 2 ABOVE CANOPY                          S1703290
            IF (CX2(N)) 350,360,350                                           S1703300
      C     FIRST CALC. DISTANCE (B55) TO HEIGHT.                             S1703310
        350 B5 = BX2(N)*BX2(N)-4.0*(AX2(N)-T3)*CX2(N)                         S1703320
            IF (B5 .LT. 0.0) B5 = 0.0                                         S1703330
            B55 = (-BX2(N)-SQRT(B5))/(2.0*CX2(N))                             S1703340
            GO TO 390                                                         S1703350
        360 IF (BX2(N)) 370,380,370                                           S1703360
        370 B55 = (T3-AX2(N))/BX2(N)                                          S1703370
            GO TO 390                                                         S1703380
        380 B55 = 0.0                                                         S1703390
      C     CALC. VS AT HEIGHT T3 FROM ABOVE CANOPY EQUATION.                 S1703400
        390 VSP = AX1(N)+B55*(BX1(N)+B55*CX1(N))                              S1703410
      C                                                                       S1703420
      C     CALC. EFFECTIVE RELEASE HEIGHT                                    S1703430
      C                                                                       S1703440
            H = T3+TIME*VSP                                                   S1703450
            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9009) B5,B55,VSP,H               S1703460
```

```
C                                                                        S1703470
C                                                                        S1703480
  400 CONTINUE                                                           S1703490
C                                                                        S1703500
      FRACT = 1.0                                                        S1703510
      XEF = XBAR                                                         S1703520
      IF (KT .EQ. 2) GO TO 590                                           S1703730
      IF (IZ .NE. 0) GO TO 440                                           S1703740
C     CALC. EFFECTIVE VS FOR ABOVE CANOPY Z.                             S1703750
      VS = AX1(N)+XEF*(BX1(N)+XEF*CX1(N))                                S1703760
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9011) VS                          S1703770
      GO TO 590                                                          S1703780
C                                                                        S1703790
C     CALC. EFFECTIVE VS FOR BELOW CANOPY Z.                             S1703800
  440 DO 450 IG=1,NTVS                                                   S1703810
  450 XDO(IG) = XP-DISTM(IZ,IG)-ABS(SL)*T9                               S1703820
C     CALC. EQUATION OF VS OVER SIZE CATEGORIES AS A FUNCTION OF         S1703830
C     DISTANCE FROM SOURCE TO POINT DROP TRAJECTORY ENTERS CANOPY.       S1703840
      CALL REGRS(NTVS,XDO,VSSS,AT,BT,CT,1)                               S1703850
C     SOLVE FOR THE INTERSECTION OF CURVE GIVEN BY AT, BT AND CT WITH    S1703860
C     THE CURVE OF VS VERSUS DISTANCE FOR DROP CATEGORY N.               S1703870
C     0 = (AT-AX1(N))+(BT-BX1(N))*X+(CT-CX1(N))*X**2                     S1703880
C                                                                        S1703890
      X1 = 1.0                                                           S1703891
      IF (CT-CX1(N)) 460,470,460                                         S1703900
C     QUADRATIC                                                          S1703901
  460 B5 = (BT-BX1(N))**2-4.0*(AT-AX1(N))*(CT-CX1(N))                    S1703910
      IF (B5 .LT. 0.0) B5 = 0.0                                          S1703920
C     DISTANCE TO INTERSECTION (XEF) OF TWO CURVES                       S1703930
      XEF = (-(BT-BX1(N))-SQRT(B5))/(2.0*(CT-CX1(N)))                    S1703940
      X1 = 0.0                                                           S1703950
      IF (XEF .GT. 0.0) GO TO 505                                        S1703951
  465 XEF = (-(BT-BX1(N))+SQRT(B5))/(2.0*(CT-CX1(N)))                    S1703952
      X1 = 1.0                                                           S1703953
      GO TO 500                                                          S1703960
C     LINEAR                                                             S1703961
  470 IF (BT-BX1(N)) 480,490,480                                         S1703970
C     DISTANCE TO INTERSECTION (XEF) OF TWO CURVES.                      S1703980
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  480 XEF = -(AT-AX1(N))/(BT-BX1(N))                                    S1703990
      IF (XEF .LT. 0.0) XEF = ABS(XEF)                                  S1704000
      GO TO 505                                                         S1704010
C     POINT                                                             S1704020
  490 IF (NTVS .GT. 1) GO TO 510                                        S1704030
      XEF = XDO(1)                                                      S1704040
  500 IF (XEF .LE. 0.0) GO TO 510                                       S1704050
C     DOUBLE CHECK THE CALCULATION OF DISTANCE XEF.                     S1704060
  505 A4 = AX1(N)+XEF*(BX1(N)+XEF*CX1(N))                               S1704061
      B4 = AT+XEF*(BT+XEF*CT)                                           S1704062
      IF (ABS(A4-B4) .LE. 0.5) GO TO 520                                S1704070
      IF (X1 .LE. 0.0) GO TO 465                                        S1704080
  510 GO TO (280,290),KT                                                S1704090
  520 IF (A4 .LE. 0.0) GO TO 510                                        S1704100
C     CALCULATE THE HEIGHT OF CURVE AT DISTANCE XEF.                    S1704110
      B55 = AX2(N)+XEF*(BX2(N)+XEF*CX2(N))                              S1704120
C     SETTLING VELOCITY VS.                                             S1704130
      VS = WSOCAN*(H-B55)/XEF                                           S1704140
      IF (VS .LE. 0.0) GO TO 510                                        S1704150
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9012) B5,XEF,A4,B4,B55,VS,AT,BT, S1704160
     *CT,XDO,VSSS                                                       S1704170
C     CALC. FRACTION OF MATERIAL THAT REACHES Z BELOW CANOPY            S1704190
C                                                                       S1704200
      DO 550 IG=1,NTVS                                                  S1704250
      IF (A4 .GE. VSSS(IG)) GO TO 560                                   S1704260
  550 CONTINUE                                                          S1704270
      IG = NTVS                                                         S1704280
C     FRACTION OF MATERIAL LEFT AFTER EVAPORATION.                      S1704290
  560 X1 = A13(IG)+Z*(B13(IG)+Z*C13(IG))                                S1704300
C     FRACTION OF MATERIAL LEFT AFTER LOSSES DUE TO IMPACTION WITHIN    S1704310
C     THE CANOPY.                                                       S1704320
      Y1 = CNTD(IZ,IG)                                                  S1704330
      IF (IG .EQ. 1) GO TO 580                                          S1704340
      IF (IG .EQ. NTVS.AND.A4 .LT. VSSS(NTVS)) GO TO 580                S1704350
C     MUST INTERPOLATE.                                                 S1704360
      B55 = VSSS(IG)-VSSS(IG-1)                                         S1704370
      IF (B55) 570,580,570                                              S1704380
  570 B5 = A13(IG-1)+Z*(B13(IG-1)+Z*C13(IG-1))                          S1704390
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      X1 = X1-(X1-B5)*(VSSS(IG)-A4)/B55                                  S1704400
      Y1 = CNTD(IZ,IG)-(VSSS(IG)-A4)*(CNTD(IZ,IG)-CNTD(IZ,IG-1))/B55     S1704410
C     FRACTION OF MATERIAL BELOW CANOPY THAT REACHES Z.                  S1704420
  580 FRACT = X1*Y1                                                      S1704430
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9013) A4,X1,Y1,B5,FRACT           S1704440
      IF (FRACT .LE. 0.0) GO TO (280,290),KT                             S1704450
  590 CONTINUE                                                           S1704460
C                                                                        S1704461
C     CALC. FRACTION OF MATERIAL REACHING CANOPY TOP (Z IF IZ = 0)       S1704462
C                                                                        S1704463
C     CALC. HEIGHT OF DROP TRAJECTORY AT DISTANCE XEF.                   S1704464
      B5 = AX2(N)+XEF*(BX2(N)+XEF*CX2(N))                                S1704465
C     CALC. FRACTION OF MATERIAL REACHING HEIGHT OF DROP TRAJECTORY      S1704466
C     AT DISTANCE XEF.                                                   S1704467
      B5 = AX3(N)+B5*(BX3(N)+B5*CX3(N))                                  S1704468
      IF (KT .NE. 2) GO TO 596                                           S1704469
C     VAPOR MODEL (VOLUME SOURCE)                                        S170446A
      IF (B5 .GT. 0.0) GO TO 595                                         S170446B
      KN = 1                                                             S170446C
      B5 = 0.0                                                           S170446D
  595 B5 = 1.0-B5                                                        S170446E
      B55 = B5                                                           S170446F
      B5 = B5-VAP                                                        S170446G
      VAP = B55                                                          S170446H
C     TOTAL FRACTION OF MATERIAL REACHING CALCULATION HEIGHT Z.          S170446I
  596 FRACT = FRACT*B5*PCTMAT(N)                                         S170446J
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9010) B5,FRACT                    S170446K
      IF (FRACT .LE. 0.0) GO TO (280,290),KT                             S170446L
C                                                                        S170446M
C                                                                        S170446N
C                                                                        S170446O
C                                                                        S170446P
      HP = H-HGTCAN(1)                                                   S1704470
C                                                                        S1704480
C                                                                        S1704490
C     CALCULATE REFLECTION COEFFICIENT                                   S1704500
      IG = 1                                                             S1704510
      IF (VS .LT. VSGAM(1)) IG = 2                                       S1704520
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      IF (VS .LT. VSGAM(2)) IG = 3                                     S1704530
      GAMMAP = GAMA(IG)+VS*(GAMB(IG)+VS*GAMC(IG))                      S1704540
      IF (GAMMAP .LT. 0.0) GAMMAP = 0.0                                S1704550
      IF (GAMMAP .GT. 1.0) GAMMAP = 1.0                                S1704560
C                                                                      S1704570
C     APPLY CORRECTION FACTOR TO SIGEPR AND SIGAPR                     S1704580
C                                                                      S1704590
      SIGEP = SIGEPR                                                   S1704600
      SIGAP = SIGAPR                                                   S1704610
      IF (BETA1) 640,640,600                                           S1704620
  600 AR2 = VS*UBARSI                                                  S1704630
      B6 = AR2*TT5                                                     S1704640
      IF (B6 .LE. .2386) GO TO 610                                     S1704650
      B6 = (TT6*AR2)**2                                                S1704660
      SIGEP = SIGEPR/(1.0+B6)**0.25                                    S1704670
      SIGAP = SIGAPR/(1.0+4.0*B6)**0.25                                S1704680
  610 A1 = SQR2*SIGAP                                                  S1704690
      A6 = 1.0/A1                                                      S1704700
      A8 = A6*UBARSI                                                   S1704710
      A5 = A6*TT3                                                      S1704720
      A7 = A5*A5                                                       S1704730
      TT5 = 1.0/SIGEP                                                  S1704740
      B1 = SIGXYZ*TT5                                                  S1704750
      A2 = SIGAP*TT5                                                   S1704760
      IF (SIGAP-SIGEP) 630,620,630                                     S1704770
  620 A2 = 1.0                                                         S1704780
  630 A3 = A2*TT10                                                     S1704790
      SK = A2                                                          S1704800
      A2 = A2*A2                                                       S1704810
      T5 = TT8*TT5                                                     S1704820
      B6 = 1.0/SIGAP                                                   S1704830
      T7 = SIGXYZ*B6                                                   S1704840
      T8 = TT8*B6                                                      S1704850
      IF (MODEL .EQ. 2) GO TO 640                                      S1704860
      SN2 = A3*TT7                                                     S1704870
      SN3 = 0.5*SN2*B6/SK                                              S1704880
  640 CONTINUE                                                         S1704890
C                                                                      S1704900
```

```
C
C     CALCULATE XLRZ
C
C
      IF (XLRZ .LT. 0.0) XLRZY = WSOCAN*TIME
      IF (KT .EQ. 2) GO TO 650
C
C     CALCULATE XZ, XY VIRTUAL DISTANCES
C
      IF (MODEL .EQ. 2) XY = T7-XLRZY
      XZ = BI-XLRZY
      SIGXI = SIGX1
      GO TO 660
  650 XZ = T5-XLRZY
      IF (MODEL .EQ. 2) XY = T8-XLRZY
      SIGXI = SIGX2
  660 IF (XZ .LT. 0.0) XZ = 0.0
      IF (MODEL.EQ.2.AND.XY.LT.0.0) XY = 0.0
C     CALC. INVERSE SIGX MULTIPLIED BY 1/SQRT(2*PI)
      B55 = DELU*XPP
      SIGXI = 1.0/(2.5066283*SQRT(B55*B55+SIGXI))
C     GO CALC. SIGY, SIGZ, AP, SB, ETC.
      CALL FOFX
      IF (API .LE. 0.0.OR.SBI .LE. 0.0) GO TO (280,290),KT
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9014) XLRZY,XZ,API,SBI,SNMYP,
     *SNMYPS,A10,UBARSI,UBARXI,A8,DEKAY,H,GAMMAP,SN2,SN3
C
C
C     CONVERT GRAMS TO DROPS IF CONV(N) IS NOT EQUAL TO 1.0
      FRACT = FRACT*CONV(N)
C
C
C     CALCULATE MODEL EQUATIONS
      GO TO (670,700,670),MODEL
C
C
C
C
```

```
C     DOSAGE, CONCENTRATION AND DEPOSITION FROM LINE SOURCES NOT        S1705290
C     NORMAL TO THE WIND DIRECTION.                                     S1705300
  670 CONTINUE                                                          S1705310
      IF (ISW(8) .LE. 0.OR.KT .EQ. 2) GO TO 680                         S1705320
C     DEPOSITION                                                        S1705330
      KSW = 0                                                           S1705340
      HPP = HP-ZP                                                       S1705350
      HMP = HM-ZP                                                       S1705360
      CALL LNPN1                                                        S1705370
      TSUM1 = TSUM1+SUMN*FRACT*(1.0-GAMMAP)*DEKAY*SN2                   S1705380
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9015) SUMN,TSUM1                 S1705390
  680 IF (ISW(6) .LE. 0.AND.ISW(7) .LE. 0) GO TO 690                    S1705400
C     DOSAGE AND/OR CONCENTRATION                                       S1705410
      KSW = 1                                                           S1705420
      HPP = HP                                                          S1705430
      HMP = HM                                                          S1705440
      CALL LNPN1                                                        S1705450
      B55 = SUMN*FRACT*DEKAY*SN3                                        S1705460
      TSUM2 = TSUM2+B55                                                 S1705470
      TSUM3 = TSUM3+B55*SIGXI                                           S1705480
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9016) SUMN,TSUM2,TSUM3,B55,SIGXI S1705490
  690 CONTINUE                                                          S1705500
      GO TO (280,290),KT                                                S1705510
C                                                                       S1705520
C                                                                       S1705530
C                                                                       S1705540
C                                                                       S1705550
C     DOSAGE, CONCENTRATION AND DEPOSITION FROM LINE SOURCES NORMAL     S1705560
C     TO THE WIND DIRECTION.                                            S1705570
  700 CONTINUE                                                          S1705580
      AR1 = T10*SIGYI                                                   S1705590
      AR2 = T11*SIGYI                                                   S1705600
      AR3 = ERFXS(AR1)                                                  S1705610
      AR4 = ERFXS(AR2)                                                  S1705620
      SUMN = 0.5*(AR3+AR4)*DEKAY*FRACT                                  S1705630
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9017) T10,T11,AR1,AR2,AR3,AR4,DEKS1705640
     *AY,FRACT,SUMN                                                     S1705650
      IF (ISW(6) .LE. 0.AND.ISW(7) .LE. 0) GO TO 710                    S1705660
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      B4 = VS*UBARXI                                                    S1705570
      A4 = -HP+ZP+B4                                                    S1705580
      B4 = HP+ZP-B4                                                     S1705590
      HMP = HM                                                          S1705700
      B55 = VRTCL(A4,B4,0)                                              S1705710
      B55 = B55*SUMN/SIGZ*SN3                                           S1705720
      TSUM2 = TSUM2+B55                                                 S1705730
      TSUM3 = TSUM3+B55*SIGXI                                           S1705740
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9018) B55,SIGYI,SIGZ,A4,B4,SIGXI S1705750
  710 IF (ISW(8) .LE. 0.OR.KT .EQ. 2) GO TO 690                         S1705760
      A4 = VS*UBARXI-(HP-ZP)                                            S1705770
      B4 = -XZ*UBARSI*VS-(HP-ZP)                                        S1705780
      HMP = HM-ZP                                                       S1705790
      B55 = VRTCL(A4,B4,1)                                              S1705800
      TSUM1 = TSUM1+B55*SUMN*SIGZI2*SN2                                 S1705810
C                                                                       S1705820
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9019) A4,B4,B55,SIGZ             S1705830
      GO TO 690                                                         S1705840
C                                                                       S1705850
C                                                                       S1705860
C                                                                       S1705870
C                                                                       S1705880
C                                                                       S1705890
C     CALCULATE FINAL RESULT                                            S1705900
C                                                                       S1705910
C                                                                       S1705920
  720 IF (ISW(8) .LE. 0) GO TO 730                                      S1705930
      CALC(II,3) = CALC(II,3)+TSUM1                                     S1705940
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9020) TSUM1,CALC(II,3)           S1705950
  730 IF (ISW(6) .LE. 0.AND.ISW(7) .LE. 0.0) GO TO 750                  S1705960
      IF (ISW(7) .LE. 0) GO TO 740                                      S1705970
      CALC(II,2) = CALC(II,2)+TSUM3                                     S1705980
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9021) TSUM3,CALC(II,2)           S1705990
  740 IF (ISW(6) .LE. 0) GO TO 750                                      S1706000
      X1 = TSUM2                                                        S1706010
      IF (ISW(10) .EQ. 1) X1 = X1*.016666667                            S1706020
      X1 = X1*UBARSI                                                    S1706030
      CALC(II,1) = CALC(II,1)+X1                                        S1706040
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      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9022) TSUM2,X1,CALC(II,1)        S1706050
  750 CONTINUE                                                          S1706060
      GO TO (170,200),M                                                 S1706070
 9001 FORMAT (16H1DETAIL SOURCE #,I3,7H DX,DY=,2F10.3,8H, DX,DY=,2F10.3)S1706080
 9002 FORMAT (7H MODEL=,I2,7H SIGAP=,E12.6,7H SIGEP=,E12.6,4H B3=,E12.6,S1706090
     *4H A1=,E12.6/4H A2=,E12.6,4H A3=,E12.6,4H SK=,E12.6,4H A6=,E12.6, S1706100
     */8H THETAP=,E12.6,4H B1=,E12.6,4H TL=,E12.6,5H GAM=,E12.6/6H ALPH=S1706110
     *,E12.6,5H BET=,E12.6,6H TSIN=,D15.8/6H TCOS=,D15.8,4H A5=,D15.8,  S1706120
     *6H RCOS=,E12.6,6H RSIN=,E12.6,4H A7=,D15.8,5H SN2=,E12.6/5H SN3=, S1706130
     *E12.6,4H T1=,E12.6,4H T2=,E12.6)                                  S1706140
 9003 FORMAT (///22H DETAIL FOR POINT I,J=,2I4,5H X,Y=,2E12.6,          S1706150
     *9H M,JJ,II=,3I4)                                                  S1706160
 9004 FORMAT (15H X1,Y1,XRR,YRR=,4E12.6)                                S1706170
 9005 FORMAT (17H XR,YR,XP,YP,XPP=,5E12.6)                              S1706180
 9006 FORMAT (12H N,IZ,MODEL=,3I8)                                      S1706190
 9007 FORMAT (20H XM,XPP,XP,YP,XR,YR=,6E14.8/17H XBAR,T10,T11,SL=,4E14.8S1706200
     *)                                                                 S1706210
 9008 FORMAT (13H VSP,B6,TIME=,3E14.8)                                  S1706220
 9009 FORMAT (14H B5,B55,VSP,H=,4E14.8)                                 S1706230
 9010 FORMAT (10H B5,FRACT=,2E14.8)                                     S1706240
 9011 FORMAT (4H VS=,E14.8)                                             S1706250
 9012 FORMAT (21H B5,XEF,A4,B4,B55,VS=,6E14.8/10H AT,BT,CT=,3E14.8/5H XDS1706260
     *0=,9E14.8/1X,9E14.8/1X,2E14.8/6H VSSS=,9E14.8/1X,9E14.8/1X,9E14.8)S1706270
 9013 FORMAT (19H A4,X1,Y1,B5,FRACT=,5E14.8)                            S1706280
 9014 FORMAT (31H XLRZY,XZ,API,SBI,SNMYP,SNMYPS=,2E14.8,4D14.8/28H A10,US1706290
     *BARSI,UBARXI,A8,DEKAY=,D14.8,2E14.8,D14.8,E14.8/10H H,GAMMAP=,2E14S1706300
     *.8,9H SN2,SN3=,2E14.8)                                            S1706310
 9015 FORMAT (12H DEP - SUMN=,D15.8,7H TSUM1=,E14.8)                    S1706320
 9016 FORMAT (16H DOS/CON - SUMN=,D15.8,7H TSUM2=,E14.8,7H TSUM3=,E14.8,S1706330
     *5H B55=,E14.8,7H SIGXI=,E14.8)                                    S1706340
 9017 FORMAT (25H T10,T11,AR1,AR2,AR3,AR4=,2E14.8,4D14.8/18H DEKAY,FRACTS1706350
     *,SUMN=,2E14.8,D14.8)                                              S1706360
 9018 FORMAT (28H B55,SIGYI,SIGZ,A4,B4,SIGXI=,6E14.8)                   S1706370
 9019 FORMAT (16H A4,B4,B55,SIGZ=,4E14.8)                               S1706380
 9020 FORMAT (13H DEP - TSUM1=,E14.8,5H DEP=,E14.8)                     S1706390
 9021 FORMAT (13H CON - TSUM3=,E14.8,                                   S1706400
     *5H CON=,E14.8)                                                    S1706410
 9022 FORMAT (13H DOS - TSUM2=,E14.8,4H X1=,E14.8,                      S1706420
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     *5H DOS=,E14.8)                                   S1706430
      END                                              S1706440
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      SUBROUTINE FOFX                                                   S1800010
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S1800020
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S1800030
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4,SB,AP                     S1800040
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S1800050
     *ISW(20),I,J,K,L,M,N,NVS                                           S1800060
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S1800070
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S1800080
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S1800090
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S1800100
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S1800110
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA    S1800120
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S1800130
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S1800140
     *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S1800150
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGXI,S1800160
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S1800170
      EQUIVALENCE (SIGZI,SNMYP),(SIGZ,SBI),(SIGYI,API),(XY,SNMYPS),     S1800180
     *(SIGZI2,APIP)                                                     S1800190
      INTEGER TITLE                                                     S1800200
      AR1 = XPP+XZ                                                      S1800210
      IF (MODEL .EQ. 2) GO TO 50                                        S1800220
      IF (MODEL .EQ. 3) GO TO 10                                        S1800230
      SNMYP = (XPP+XZ*TT1-YR*TSIN)*TT2                                  S1800240
      GO TO 20                                                          S1800250
   10 SNMYP = YP                                                        S1800260
   20 CONTINUE                                                          S1800270
      SNMYPS = SNMYP*SNMYP                                              S1800280
      A10 = A5*SNMYP                                                    S1800290
      AP = A1*AR1                                                       S1800300
      IF (AP .LT. 1.0E-20.AND.AP .GE. 0.0) AP = 1.0E-20                 S1800310
      API = 1.0/AP                                                      S1800320
      IF (SL .GE. 0.0) GO TO 30                                         S1800330
      SB = A1*(AR1-TT4)                                                 S1800340
      GO TO 40                                                          S1800350
   30 SB = A1*XZ                                                        S1800360
   40 IF (SB .LT. 1.0E-20.AND.SB .GE. 0.0) SB = 1.0E-20                 S1800370
      SBI = 1.0/SB                                                      S1800380
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      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9001) XPP,XZ,A1,SL,TSIN,AP,SB     S1800390
   50 CONTINUE                                                          S1800400
      UBARXI = XZ*UBARSI                                                S1800410
      IF (MODEL .NE. 2) GO TO 60                                        S1800420
      SIGZ = SIGEP*AR1                                                  S1800430
      SIGYI = 1.0/(SIGAP*(XPP+XY))                                      S1800440
      SIGZI2 = 1.0/(SIGZ*AR1)                                           S1800450
      UBARXI = XPP*UBARSI                                               S1800460
      SIGZI = -0.5/(SIGZ*SIGZ)                                          S1800470
   60 CONTINUE                                                          S1800480
      DEKAY = 1.0                                                       S1800490
      IF (DECAY) 70,90,70                                               S1800500
   70 CONTINUE                                                          S1800510
      SB = -DECAY*XPP*UBARSI                                            S1800520
      IF (SB .GT. 50.0) SB = 50.0                                       S1800530
      IF (SB .LT. -50.0) SB = -50.0                                     S1800540
      IF (MODEL .EQ. 2) GO TO 80                                        S1800550
      DEKAY = (WSOCAN/(XPP*DECAY))*(1.0-DEXP(SB))                       S1800560
      GO TO 90                                                          S1800570
   80 DEKAY = DEXP(SB)                                                  S1800580
   90 CONTINUE                                                          S1800590
      RETURN                                                            S1800600
 9001 FORMAT (25H XPP,XZ,A1,SL,TSIN,AP,SB=,7E12.6)                      S1800610
      END                                                               S1800620
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      FUNCTION ERFXS(X)                                                 S1900010
C     ERROR FUNCTION                                                    S1900020
      DOUBLE PRECISION A1,A2,A3,A4,A5,A6,X,A,B                          S1900030
      DATA A1,A2,A3,A4,A5,A6/.0705230784D0,.0422820123D0,.0092705272D0, S1900040
     *.0001520143D0,.0002765672D0,.0000430638D0/                        S1900050
      I = 0                                                             S1900060
      IF (X .LT. 0.0) I = 1                                             S1900070
      A = DABS(X)                                                       S1900080
      IF (A .LE. 1.0E-11) GO TO 30                                      S1900090
      IF (A .GE. 5.0) GO TO 10                                          S1900100
      B = 1.0+A*(A1+A*(A2+A*(A3+A*(A4+A*(A5+A*A6)))))                   S1900110
      A = 1.0-1.0/B**16                                                 S1900120
      GO TO 20                                                          S1900130
   10 A = 1.0                                                           S1900140
   20 IF (I .NE. 0) A = -A                                              S1900150
   30 ERFXS = A                                                         S1900160
      RETURN                                                            S1900170
      END                                                               S1900180
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```
      FUNCTION VRTCL(P1,P2,LL)                                          S2000010
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S2000020
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S2000030
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4,SB,AP                     S2000040
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S2000050
     *ISW(20),I,J,K,L,M,N,NVS                                           S2000060
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S2000070
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUD,SIGXYZ,XLRZ,   S2000080
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEFLV(10),   S2000090
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S2000100
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S2000110
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA    S2000120
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S2000130
      COMMON /COM3/ CALC(737,3),XPF,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6.  S2000140
     *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S2000150
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S2000160
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S2000170
      EQUIVALENCE (SIGZI,SNMYP),(SIGZ,SBI),(SIGYI,API),(XY,SNMYPS)      S2000180
      INTEGER TITLE                                                     S2000190
      RESLT = 0.0                                                       S2000200
      IF (SIGZI .GE. 0.0) GO TO 40                                      S2000210
      IF (LL .NE. 0) GO TO 50                                           S2000220
      AR1 = P2*P2*SIGZI                                                 S2000230
      IF (AR1 .LT. -40.0) GO TO 40                                      S2000240
      AR2 = P1*P1*SIGZI                                                 S2000250
      IF (AR2 .LT. -40.0) GO TO 10                                      S2000260
      RESLT = DEXP(AR2)                                                 S2000270
   10 RESLT = RESLT+DEXP(AR1)*GAMMAP                                    S2000280
      AR1 = 1.0                                                         S2000290
      AR2 = GAMMAP                                                      S2000300
      AR3 = AR2*AR2                                                     S2000310
      KSW = 0                                                           S2000320
   20 KSW = KSW+2                                                       S2000330
      AR4 = KSW*HMP                                                     S2000340
      AR5 = AR4-P2                                                      S2000350
      AR5 = AR5*AR5*SIGZI                                               S2000360
      IF (AR5 .LT. -40.0) AR5 = -40.0                                   S2000370
      IF (KSW .LE. 2) GO TO 30                                          S2000380
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      IF (AR5 .LT. -10.0) GO TO 40                                      S2000390
   30 T2 = AR4+P1                                                       S2000400
      T3 = AR4-P1                                                       S2000410
      T4 = AR4+P2                                                       S2000420
      T2 = T2*T2*SIGZI                                                  S2000430
      T3 = T3*T3*SIGZI                                                  S2000440
      T4 = T4*T4*SIGZI                                                  S2000450
      IF (T2 .LT. -40.0) T2 = -40.0                                     S2000460
      IF (T3 .LT. -40.0) T3 = -40.0                                     S2000470
      IF (T4 .LT. -40.0) T4 = -40.0                                     S2000480
      BB2 = AR1*DEXP(AR5)+AR2*(EXP(T2)+EXP(T3))+AR3*EXP(T4)             S2000490
      RESLT = RESLT+BB2                                                 S2000500
      IF (BB2 .LE. RESLT*1.0E-6) GO TO 40                               S2000510
      IF (GAMMAP .LE. 0.0) GO TO 40                                     S2000520
      AR1 = AR2                                                         S2000530
      AR2 = AR3                                                         S2000540
      AR3 = AR3*GAMMAP                                                  S2000550
      GO TO 20                                                          S2000560
   40 CONTINUE                                                          S2000570
      VRTCL = RESLT                                                     S2000580
      RETURN                                                            S2000590
   50 IF (GAMMAP .GE. 1.0) GO TO 40                                     S2000600
      AR1 = P1*P1*SIGZI                                                 S2000610
      IF (AR1 .LT. -40.0) AR1 = -40.0                                   S2000620
      RESLT = -P2*DEXP(AR1)                                             S2000630
      AR1 = 1.0                                                         S2000640
      KSW = 0                                                           S2000650
   60 KSW = KSW+2                                                       S2000660
      AR4 = KSW*HMP                                                     S2000670
      AR5 = AR4-P1                                                      S2000680
      AR2 = AR4+P1                                                      S2000690
      AR5 = AR5*AR5*SIGZI                                               S2000700
      AR2 = AR2*AR2*SIGZI                                               S2000710
      IF (KSW .LE. 2) GO TO 70                                          S2000720
      IF (AR5 .LT. -10.0.AND.AR2 .LT. -10.0) GO TO 80                   S2000730
   70 RESLT = RESLT+AR1*((AR4+P2)*DEXP(AR2)+GAMMAP*(AR4-P2)*DEXP(AR5)   S2000740
     *)                                                                 S2000750
      IF (GAMMAP .LE. 0.0) GO TO 80                                     S2000760
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      AR1 = AR1*GAMMAP                                                  S2000770
      GO TO 60                                                          S2000780
   80 RESLT = RESLT*(1.0-GAMMAP)                                        S2000790
      GO TO 40                                                          S2000800
      END                                                               S2000810
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      SUBROUTINE LNPN1                                                  S2100010
C     KSW = 0 IS DEPOSITION                                             S2100020
C     KSW = 1 IS DOSAGE (CONCENTRATION)                                 S2100030
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S2100040
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S2100050
     *,SBI,API,A8,XR,YR,A7,A?,TT1,TT2,TT3,TT4,TMP1,TMP2,TMP3,TMP4,      S2100060
     *SUM,BB,TMP5,TMP6                                                  S2100070
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S2100080
     *ISW(20),I,J,K,L,M,N,NVS                                           S2100090
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S2100100
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S2100110
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S2100120
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S2100130
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S2100140
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA    S2100150
     *,BFTA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S2100160
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6   S2100170
     *SNMYP,SNMYPS,A10,AFI,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S2100180
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S2100190
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S2100200
      INTEGER TITLE                                                     S2100210
      SUMN = 0.0                                                        S2100220
      GAM1 = 1.0                                                        S2100230
      GAM2 = GAMMAP                                                     S2100240
      TMP6 = VS*A8                                                      S2100250
      TMP2 = SNMYPS/A2                                                  S2100260
      TMP3 = TMP6*A2                                                    S2100270
      TMP1 = TMP6*SK                                                    S2100280
      TMP5 = A10/SK                                                     S2100290
      PP = TMP6*TMP3+A7                                                 S2100300
      BB = HPP+VS*UBARXI                                                S2100310
      APIP = API                                                        S2100320
      SBIP = SBI                                                        S2100330
      BB1 = BB                                                          S2100340
      BB2 = SQRP                                                        S2100350
      IF (KSW .NE. 0) GO TO 10                                          S2100360
      FF = A2*BB*BB+SNMYPS                                              S2100370
      GG = 2.0*(TMP3*BB+A10)                                            S2100380
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      GO TO 20                                                          S2100390
   10 BB1 = 3.14159265                                                  S2100400
      TMP4 = -BB+ZP                                                     S2100410
      FF = TMP2+TMP4*TMP4                                               S2100420
      GG = -2.0*(TMP1*TMP4-TMP5)                                        S2100430
      APIP = API*SK                                                     S2100440
      SBIP = SBI*SK                                                     S2100450
   20 CALL LNPN2(1.0)                                                   S2100460
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9001) TMP1,TMP2,TMP3,PP,BB,APIP, S2100470
     *SBIP,BB1,BB2,FF,GG,TMP4,A2,SNMYPS                                 S2100480
      SUMN = SUMN+RESLT                                                 S2100490
      IF (KSW .EQ. 0) GO TO 30                                          S2100500
      TMP4 = BB+ZP                                                      S2100510
      FF = TMP2+TMP4*TMP4                                               S2100520
      GG = 2.0*(TMP1*TMP4+TMP5)                                         S2100530
      CALL LNPN2(GAM2)                                                  S2100540
      SUMN = SUMN+RESLT                                                 S2100550
      GAM3 = GAM2*GAMMAP                                                S2100560
      GO TO 40                                                          S2100570
   30 CONTINUE                                                          S2100580
   40 AA = 0.0                                                          S2100590
   50 AA = AA+2.0                                                       S2100600
      CC = AA*HM                                                        S2100610
      SUM = 0.0                                                         S2100620
      IF (KSW .NE. 0) GO TO 60                                          S2100630
      BB1 = CC-BB                                                       S2100640
      FF = A2*BB1*BB1+SNMYPS                                            S2100650
      GG = -2.0*(TMP3*BB1-A10)                                          S2100660
      GO TO 70                                                          S2100670
   60 TMP4 = CC-BB-ZP                                                   S2100680
      FF = TMP2+TMP4*TMP4                                               S2100690
      GG = -2.0*(TMP1*TMP4-TMP5)                                        S2100700
   70 CALL LNPN2(GAM1)                                                  S2100710
      SUM = SUM+RESLT                                                   S2100720
      IF (KSW .NE. 0) GO TO 80                                          S2100730
      BB1 = CC+BB                                                       S2100740
      FF = A2*BB1*BB1+SNMYPS                                            S2100750
      GG = 2.0*(TMP3*BB1+A10)                                           S2100760
```

```
      GO TO 90
   80 TMP4 = CC+BB-ZP
      FF = TMP2+TMP4*TMP4
      GG = 2.0*(TMP1*TMP4+TMP5)
   90 CALL LNPN2(GAM2)
      SUM = SUM+RESLT
      IF (KSW .EQ. 0) GO TO 100
      TMP4 = CC-BB+ZP
      FF = TMP2+TMP4*TMP4
      GG = -2.0*(TMP1*TMP4-TMP5)
      CALL LNPN2(GAM2)
      SUM = SUM+RESLT
      TMP4 = CC+BB+ZP
      FF = TMP2+TMP4*TMP4
      GG = 2.0*(TMP1*TMP4+TMP5)
      CALL LNPN2(GAM3)
      SUM = SUM+RESLT
      GAM3 = GAM3*GAMMAP
  100 IF (GAMMAP .LE. 0.0) GO TO 120
      GAM1 = GAM2
      GAM2 = GAM2*GAMMAP
      IF (AA .LE. 2.0) GO TO 110
      IF (SUM .LE. 1.0E-6*SUMN) GO TO 120
  110 SUMN = SUMN+SUM
      GO TO 50
  120 SUMN = SUMN+SUM
      RETURN
 9001 FORMAT (14H LNPN1 - TMP1=,D20.12,6H TMP2=,D20.12,6H TMP3=,D20.12,
     */4H PP=,D20.12,4H BB=,D20.12,6H APIP=,D20.12/
     *6H SRIP=,D20.12,5H BB1=,D20.12,5H BB2=,D20.12/
     *4H FF=,D20.12,4H GG=,D20.12,6H TMP4=,D20.12/
     *4H A2=,D20.12,8H SNMYPS=,D20.12)
      END
```

```
      SUBROUTINE LNPN2(GAM)                                             S2200010
C     KSW = 0 IS DEPOSITION                                             S2200020
C     KSW = 1 IS DOSAGE (CONCENTRATION)                                 S2200030
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S2200040
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S2200050
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4,TMP1,TMP2,TMP3            S2200060
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S2200070
     *ISW(20),I,J,K,L,M,N,NVS                                           S2200080
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S2200090
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S2200100
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S2200110
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S2200120
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S2200130
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA    S2200140
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S2200150
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S2200160
     *SNMYP,SNMYPS,A10,AFI,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S2200170
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S2200180
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S2200190
      INTEGER TITLE                                                     S2200200
      TMP1 = DSQRT(FF)                                                  S2200210
      TMP2 = 0.5/FF                                                     S2200220
      TMP3 = GG*TMP2                                                    S2200230
      AR1 = BB1*TMP2                                                    S2200240
      AR2 = 0.5*GG*TMP3-PP                                              S2200250
      AR3 = (APIP-TMP3)*TMP1                                            S2200260
      AR4 = (SBIP-TMP3)*TMP1                                            S2200270
      IF (KSW .EQ. 1) GO TO 10                                          S2200280
      AR5 = (GG*0.5/TMP1)*BB2                                           S2200290
      GO TO 20                                                          S2200300
   10 AR1 = DSQRT(AR1)                                                  S2200310
      AR5 = 1.0                                                         S2200320
   20 RESLT = AR5*(ERFXS(AR4)-ERFXS(AR3))                               S2200330
      IF (KSW .NE. 0) GO TO 30                                          S2200340
      AR4 = AR4*AR4                                                     S2200350
      AR3 = AR3*AR3                                                     S2200360
      TMP2 = 0.0                                                        S2200370
      IF (AR4 .LT. 50.0) TMP2 = DEXP(-AR4)                              S2200380
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      TMP3 = 0.0                                                        S2200390
      IF (AR3 .LT. 50.0) TMP3 = DEXP(-AR3)                              S2200400
      RESLT = RESLT+(TMP3-TMP2)                                         S2200410
   30 IF (AR2 .GT. 50.0) AR2 = 50.0                                     S2200420
      TMP2 = 0.0                                                        S2200430
      IF (AR2 .GT. -50.0) TMP2 = DEXP(AR2)                              S2200440
      RESLT = AR1*TMP2*RESLT*GAM                                        S2200450
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9001) KSW,BB1,FF,GG,PP,APIP,SBIP,S2200460
     *BB2,AR1,AR2,AR3,AR4,AR5,TMP1,RESLT                                S2200470
      IF (RESLT .LT. 0.0) RESLT = 0.0                                   S2200480
      RETURN                                                            S2200490
 9001 FORMAT (5H KSW=,I2,5H BB1=,D15.8,4H FF=,D15.8,4H GG=,D15.8,       S2200500
     *4H PP=,D15.8/6H APIP=,D15.8,6H SBIP=,D15.8,5H BB2=,D15.8,         S2200510
     *5H AR1=,D15.8/5H AR2=,D15 8,5H AR3=,D15.8,5H AR4=,D15.8,5H AR5=,  S2200520
     *D15.8/6H TMP1=,D15.8,7H RESLT=,D15.8)                             S2200530
      END                                                               S2200540
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      SUBROUTINE CBGS6                                                  S2300010
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S2300020
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S2300030
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4                           S2300040
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S2300050
     *ISW(20),I,J,K,L,M,N,NVS                                           S2300060
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S2300070
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S2300080
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S2300090
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S2300100
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S2300110
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA    S2300120
     *,BFTA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S2300130
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S2300140
     *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S2300150
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S2300160
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S2300170
      DIMENSION AREAC(10,3),CONS1(6),CONS2(5)                           S2300180
      EQUIVALENCE (AREAC(1,1),DOSLV(1)),(COVR,BB1),(NXXYY,AR5),(CMAX,AR1S2300190
     *),(XMX,AR2),(YMX,AR3),(CONST,AR4)                                 S2300200
      INTEGER TITLE                                                     S2300210
      DATA CONS1/1.0,1.0E6,1.0E3,1.0,.035274,.002204623/                S2300220
      DATA CONS2/2.83169E-2,9.290339E-2,4046.873,1.0,10000.0/           S2300230
C                                                                       S2300240
C     SUBROUTINE TO PRINT DISPERSION MODEL CALCULATIONS                 S2300250
C                                                                       S2300260
C                                                                       S2300270
      NXXYY = NXPNTS*NYPNTS                                             S2300280
      DO 230 K=1,3                                                      S2300290
      IF (ISW(K+5) .LE. 0) GO TO 230                                    S2300300
      IF (K .EQ. 3) GO TO 10                                            S2300310
      IF (Z .GE. HGTCAN(1)) GO TO 10                                    S2300320
      WRITE (IOTFIL,9001)                                               S2300330
      GO TO 230                                                         S2300340
   10 CONTINUE                                                          S2300350
      I = ISW(9)+1                                                      S2300360
      CONST = CONS1(I)                                                  S2300370
      I = 4                                                             S2300380
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      IF (K .EQ. 3) GO TO 20                                            S2300390
      IF (ISW(11) .EQ. 1.OR.ISW(11) .EQ. 3) I = 1                       S2300400
      GO TO 30                                                          S2300410
   20 IF (ISW(11) .EQ. 1) I = 2                                         S2300420
      IF (ISW(11) .GE. 2) I = 3                                         S2300430
      IF (ISW(11) .EQ. 4) I = 4                                         S2300440
   30 CONST = CONST*CONS2(I)                                            S2300450
      LINE = 57                                                         S2300460
C     DETERMINE MAXIMUM VALUE AND LOCATION                              S2300470
      CMAX = 0.0                                                        S2300480
      XMX = X(1)                                                        S2300490
      YMX = Y(1)                                                        S2300500
      IF (NYPNTS .LE. 0) GO TO 50                                       S2300510
      DO 40 J=1,NYPNTS                                                  S2300520
      I1 = (J-1)*NXPNTS                                                 S2300530
      DO 40 I=1,NXPNTS                                                  S2300540
      CALC(I+I1,K) = CALC(I+I1,K)*CONST                                 S2300550
      IF (CALC(I+I1,K) .LE. CMAX) GO TO 40                              S2300560
      CMAX = CALC(I+I1,K)                                               S2300570
      XMX = X(I)                                                        S2300580
      YMX = Y(J)                                                        S2300590
   40 CONTINUE                                                          S2300600
   50 IF (NXYPNT .LE. 0) GO TO 70                                       S2300610
      DO 60 I=1,NXYPNT                                                  S2300620
      CALC(I+NXXYY,K) = CALC(I+NXXYY,K)*CONST                           S2300630
      IF (CALC(I+NXXYY,K) .LE. CMAX) GO TO 60                           S2300640
      CMAX = CALC(I+NXXYY,K)                                            S2300650
      XMX = X(NXPNTS+I)                                                 S2300660
      YMX = Y(NYPNTS+I)                                                 S2300670
   60 CONTINUE                                                          S2300680
   70 CONTINUE                                                          S2300690
C                                                                       S2300700
C     PRINT CALCULATIONS AT GRID SYSTEM RECEPTORS                       S2300710
C                                                                       S2300720
      I4 = 1                                                            S2300730
      I2 = 0                                                            S2300740
   80 I1 = I2+1                                                         S2300750
      IF (I1 .GT. NXPNTS) GO TO 110                                     S2300760
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      I2 = I1+8                                                         S2300770
      IF (I2 .GT. NXPNTS) I2 = NXPNTS                                   S2300780
      I3 = NYPNTS+1                                                     S2300790
   90 I3 = I3-1                                                         S2300800
      IF (I3 .LE. 0) GO TO 100                                          S2300810
      I5 = (I3-1)*NXPNTS                                                S2300820
      CALL TITLR(I4,CMAX,XMX,YMX,I1,I2,0)                               S2300830
      I4 = 0                                                            S2300840
      WRITE (IOTFIL,9002) Y(I3),(CALC(I5+I,K),I=I1,I2)                  S2300950
      GO TO 90                                                          S2300860
  100 I4 = -1                                                           S2300870
      GO TO 80                                                          S2300980
C                                                                       S2300890
C     PRINT CALCULATIONS AT DISCRETE RECEPTORS                          S2300900
C                                                                       S2300910
  110 I2 = 0                                                            S2300920
      IF (NXPNTS .GT. 0) I4 = -1                                        S2300930
  120 I1 = I2+1                                                         S2300940
      IF (I1 .GT. NXYPNT) GO TO 130                                     S2300950
      I2 = I1+2                                                         S2300960
      IF (I2 .GT. NXYPNT) I2 = NXYPNT                                   S2300970
      CALL TITLR(I4,CMAX,XMX,YMX,I1,I2,1)                               S2300980
      I4 = 0                                                            S2300990
      WRITE (IOTFIL,9003) (X(NXPNTS+I),Y(NYPNTS+I),CALC(I+NXXYY,K),I=I1,S2301000
     *I2)                                                               S2301010
      GO TO 120                                                         S2301020
  130 IF (ISW(12) .LE. 0) GO TO 230                                     S2301030
C                                                                       S2301040
C     CALCULATE AREA OF COVERAGE                                        S2301050
C                                                                       S2301060
      IF (AREAC(1,K) .LE. 0.0) GO TO 230                                S2301070
      I4 = -1                                                           S2301080
      DO 220 I3=1,10                                                    S2301090
      COVR = 0.0                                                        S2301100
      IF (NYPNTS .LE. 0) GO TO 190                                      S2301110
      DO 180 J=1,NYPNTS                                                 S2301120
      I1 = (J-1)*NXPNTS                                                 S2301130
      YP = Y(1)                                                         S2301140
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      YR = Y(1)+100.0                                                   S2301150
      IF (NYPNTS .LE. 1) GO TO 150                                      S2301160
      YR = Y(2)                                                         S2301170
      IF (J .EQ. 1) GO TO 150                                           S2301180
      IF (J .NE. NYPNTS) GO TO 140                                      S2301190
      YP = Y(NYPNTS-1)                                                  S2301200
      YR = Y(NYPNTS)                                                    S2301210
      GO TO 150                                                         S2301220
  140 YP = 0.5*(Y(J+1)-Y(J-1))                                          S2301230
      YR = 0.0                                                          S2301240
  150 YP = YP-YR                                                        S2301250
      DO 180 I=1,NXPNTS                                                 S2301260
      IF (CALC(I+I1,K) .LT. AREAC(I3,K)) GO TO 180                      S2301270
      XP = X(1)                                                         S2301280
      XR = X(1)+100.0                                                   S2301290
      IF (NXPNTS .LE. 1) GO TO 170                                      S2301300
      XR = X(2)                                                         S2301310
      IF (I .EQ. 1) GO TO 170                                           S2301320
      IF (I .NE. NXPNTS) GO TO 160                                      S2301330
      XP = X(NXPNTS-1)                                                  S2301340
      XR = X(NXPNTS)                                                    S2301350
      GO TO 170                                                         S2301360
  160 XP = 0.5*(X(I+1)-X(I-1))                                          S2301370
      XR = 0.0                                                          S2301380
  170 XP = XP-XR                                                        S2301390
      COVR = COVR+ABS(YP*XP)                                            S2301400
  180 CONTINUE                                                          S2301410
  190 IF (NXYPNT .LE. 0) GO TO 210                                      S2301420
C                                                                       S2301430
C     AREA OF COVERAGE FOR DISCRETE RECEPTORS                           S2301440
C                                                                       S2301450
      DO 200 I=1,NXYPNT                                                 S2301460
      IF (CALC(I+NXXYY,K) .LT. AREAC(I3,K)) GO TO 200                   S2301470
      COVR = COVR+DAREA                                                 S2301480
  200 CONTINUE                                                          S2301490
  210 CALL TITLR(I4,CMAX,XMX,YMX,I1,I2,2)                               S2301500
      I4 = 0                                                            S2301510
      IF (ISW(11) .EQ. 1) COVR = COVR*10.76387                          S2301520
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      IF (ISW(11) .GE. 2) COVR = COVR*2.47104E-4                        S2301530
      WRITE (IOTFIL,9004) AREAC(I3,K),COVR                              S2301540
  220 CONTINUE                                                          S2301550
  230 CONTINUE                                                          S2301560
      WRITE (IOTFIL,9005)                                               S2301570
      STOP                                                              S2301580
 9001 FORMAT (67H1 *** ERROR - CANNOT CALCULATE DOSAGE OR CONCENTRATION S2301590
     *BELOW CANOPY)                                                     S2301600
 9002 FORMAT (1X,F9.2,9E13.6)                                           S2301610
 9003 FORMAT (3(1X,F9.2,3X,F9.2,2X,E13.4))                              S2301620
 9004 FORMAT (46X,E14.8,7X,E14.8)                                       S2301630
 9005 FORMAT (38H1 ******* END OF FSCBG PROGRAM *******)                S2301640
      END                                                               S2301650
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      SUBROUTINE TITLR(IN,CMAX,XMX,YMX,J1,J2,JN)                        S2400010
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S2400020
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMH         S2400030
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4                           S2400040
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S2400050
     *ISW(20),I,J,K,L,M,N,NVS                                           S2400060
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S2400070
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S2400080
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S2400090
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S2400100
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S2400110
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA    S2400120
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S2400130
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S2400140
     *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S2400150
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMH,SIGX1,S2400160
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S2400170
      DIMENSION LABL1(5,6),LABL2(2,3),LABL3(28),LABL4(7,3)              S2400180
      INTEGER TITLE                                                     S2400190
      DATA LABL1/2HDR,2HOP,1HS,2*1H ,2HMI,2HCR,2HOG,2HRA,2HMS,          S2400200
     *           2HMI,2HLL,2HIG,2HRA,2HMS,2HGR,2HAM,2HS ,2H  ,2H  ,     S2400210
     *           2HOU,2HNC,2HES,2H  ,2H  ,2HPO,2HUN,2HDS,2H  ,2H  /     S2400220
      DATA LABL2/2HSE,2HC.,2HMI,2HN.,2*1H /                             S2400230
      DATA LABL3/2HCU,2HBI,1HC,1H ,2HSQ,2HUA,2HRE,1H ,2HME,2HTE,1HR,1H ,S2400240
     *       2HFO,2HOT,2*1H ,2HAC,2HRE,2*1H ,2HHE,2HCT,2HAR,1HE,4*1H /  S2400250
      DATA LABL4/2HDO,2HSA,2HGE,4*1H ,2HCO,2HNC,2HEN,2HTR,2HAT,2HIO,1HN,S2400260
     *           2HDE,2HPO,2HSI,2HTI,2HON,2*1H /                        S2400270
      IF (IN .LT. 0) GO TO 30                                           S2400280
      IF (IN .EQ. 1) GO TO 10                                           S2400290
      LINE = LINE+1                                                     S2400300
      IF (LINE .LT. 57) GO TO 160                                       S2400310
   10 LINE = 3                                                          S2400320
      IPAGE = IPAGE+1                                                   S2400330
      WRITE (IOTFIL,9001) (TITLE(I),I=1,20),IDATE,IPAGE                 S2400340
      IF (IN .EQ. 1) GO TO 20                                           S2400350
      WRITE (IOTFIL,9002) ITABLE                                        S2400360
      GO TO 40                                                          S2400370
   20 ITABLE = ITABLE+1                                                 S2400380
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      WRITE (IOTFIL,9003) ITABLE                                          S2400390
      GO TO 40                                                            S2400400
   30 IF (LINE+10 .GE. 57) GO TO 10                                       S2400410
      WRITE (IOTFIL,9004)                                                 S2400420
      LINE = LINE+5                                                       S2400430
      GO TO 130                                                           S2400440
   40 L1 = ISW(9)+1                                                       S2400450
      GO TO (50,60,80),K                                                  S2400460
   50 L2 = 1                                                              S2400470
      IF (ISW(10) .NE. 0) L2 = 2                                          S2400480
      GO TO 70                                                            S2400490
   60 L2 = 3                                                              S2400500
   70 L3 = 0                                                              S2400510
      L4 = 8                                                              S2400520
      IF (ISW(11) .EQ. 1.OR.ISW(11) .EQ. 3) L4 = 12                       S2400530
      GO TO 100                                                           S2400540
   80 L2 = 3                                                              S2400550
      L3 = 4                                                              S2400560
      IF (ISW(11) .GE. 2) GO TO 90                                        S2400570
      L4 = 8                                                              S2400580
      IF (ISW(11) .EQ. 1) L4 = 12                                         S2400590
      GO TO 100                                                           S2400600
   90 L3 = 16                                                             S2400610
      IF (ISW(11) .EQ. 4) L3 = 20                                         S2400620
      L4 = 24                                                             S2400630
  100 L5 = 4                                                              S2400640
      L6 = 8                                                              S2400650
      IF (ISW(11) .EQ. 0) GO TO 110                                       S2400660
      L6 = 12                                                             S2400670
      IF (ISW(11) .EQ. 1) GO TO 110                                       S2400680
      L5 = 16                                                             S2400690
      IF (ISW(11) .EQ. 4) L5 = 20                                         S2400700
      L6 = 24                                                             S2400710
  110 CONTINUE                                                            S2400720
      WRITE (IOTFIL,9005) (LABL4(L,K),L=1,7),(LABL1(L,L1),L=1,5),(LABL2(S2400730
     *L,L2),L=1,2),(LABL3(L+L3),L=1,4),(LABL3(L+L4),L=1,4),Z              S2400740
      LINE = LINE+3                                                       S2400750
      IF (JN .EQ. 2) GO TO 120                                            S2400760
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      WRITE (IOTFIL,9006) (LABL4(L,K),L=1,7),CMAX,XMX,YMX                S2400770
      LINE = LINE+1                                                      S2400780
  120 WRITE (IOTFIL,9007)                                                S2400790
      LINE = LINE+2                                                      S2400800
  130 IF (JN .NE. 0) GO TO 140                                           S2400810
      WRITE (IOTFIL,9008) (X(L),L=J1,J2)                                 S2400820
      WRITE (IOTFIL,9009) (LABL4(L,K),L=1,7)                             S2400830
      LINE = LINE+5                                                      S2400840
      GO TO 160                                                          S2400850
  140 IF (JN .NE. 1) GO TO 150                                           S2400860
      WRITE (IOTFIL,9010) ((LABL4(L,K),L=1,7),M=1,3)                     S2400870
      LINE = LINE+4                                                      S2400880
      GO TO 160                                                          S2400890
  150 WRITE (IOTFIL,9011) ((LABL4(L,K),L=1,7),M=1,2),(LABL3(L+L5),L=1,4)S2400900
     *,(LABL3(L+L6),L=1,4)                                               S2400910
      LINE = LINE+5                                                      S2400920
  160 RETURN                                                             S2400930
 9001 FORMAT (24H1FOREST SPRAY MODEL *** ,20A4,10H *** DATE ,2(I2,1H/), S2400940
     *I2,7H, PAGE ,I3/)                                                  S2400950
 9002 FORMAT (58X,6HTABLE ,I2,8H (CONT.))                                S2400960
 9003 FORMAT (62X,6HTABLE ,I2)                                           S2400970
 9004 FORMAT (////)                                                      S2400980
 9005 FORMAT (/40X,4H*-* ,7A2,1H(,5A2,1X,2A2,1H/,3A2,A1,1X,3A2,A1,5H) *-S2400990
     **/40X,3H*-*,8X,15HAT A HEIGHT OF ,F8.4,7H METERS,8X,3H*-*)         S2401000
 9006 FORMAT (32X,9H(MAXIMUM ,7A2,1H=,E13.7,6H AT X=,F10.3,4H, Y=,F10.3,S2401010
     *1H))                                                               S2401020
 9007 FORMAT (/)                                                         S2401030
 9008 FORMAT (8H  Y AXIS,40X,19H- X AXIS (METERS) -/9H (METERS),9(3X,F9.S2401040
     *2,1X))                                                             S2401050
 9009 FORMAT (39X,2H- ,7A2,2H -/1X,63(2H--))                             S2401060
 9010 FORMAT (46X,22H- DISCRETE RECEPTORS -/3(24H X (METERS)  Y (METERS)S2401070
     * ,7A2)/1X,57(2H--))                                                S2401080
 9011 FORMAT (47X,22H- AREA OF COVERAGE OF ,7A2,2H -/46X,7A2,6X,6HAREA (S2401090
     *,3A2,A1,1X,3A2,A1,1H)/46X,7(2H--),6X,10(2H--)/)                    S2401100
      END                                                                S2401110
```

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